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Thomas A. Edison Papers

A SELECTIVE MICROFILM EDITION

PART II
(1879–1886)

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1987

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at
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THOMAS A. EDISON PAPERS

A SELECTIVE MICROFILM EDITION
PART II
(1879-1886)

REEL 33

NOTEBOOK SERIES (NBK-11)

Menlo Park Notebooks, #47 - #58

Menlo Park Notebook #47 [N-79-03-20]

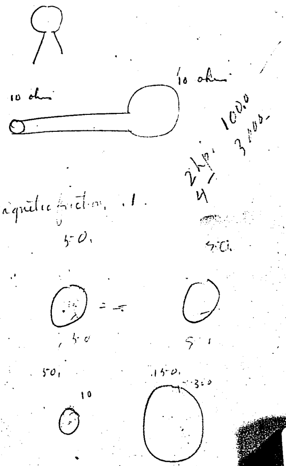
The dated entries in this book begin on page 165 and cover the period March-April 1879. However, the book was probably begun in December 1878. Most of the entries are by Francis Upton. There are also entries by Edison, Charles Batchelor, and Francis Jehl. Included are notes, drawings, and tests of lamps; notes, drawings, and calculations about generators; notes and calculations about meters and electric power distribution; notes and drawings of dynamometers; drawings of the telephone; and notes, drawings, and calculations about electrolysis. There are also notes by Edison on a law of "Proportion of Resistance." The book contains 282 numbered pages.

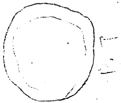
Blank pages not filmed: 54-55.

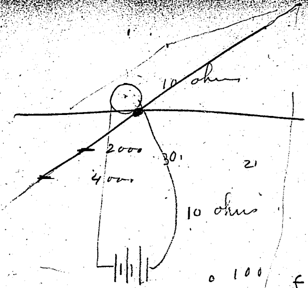
Missing page numbers: 123-134, 235-238, 243-246.

No 47

1


10 ohms
10 ohms
1000
2 hp 3000
4
magnetic friction .1
50.
50.
50
5
50
.150
300
10





0 100

f 50 f

75 25

85 85

100, 100,

c f

5 51. 49,

52 48

1000 20 Emf orionf

Siemens,
per hp;

10 in 10 out. $8\frac{1}{10}$.

2000 20

Siemens;
5 in 10 out. $10\frac{2}{10}$.

1000.
Perfect 20

10 in 10 out. 10.

2000
5 in 10 out 15

Proportion of Resistance 20-Emf

4. 1 hp 1000
Wallace per hp $2\frac{1}{2}$ useful
4 1 hp 10 in 10 out,

Wallace 2000
15 out
5 in. $2\frac{1}{7}$ useful

Gramme;

~~4~~. 1 hp 1000 ~~20~~
10 in 10 out, —— ~~5~~ useful

4. 1 hp 2000
5 in 15 out 5 useful
4000 20

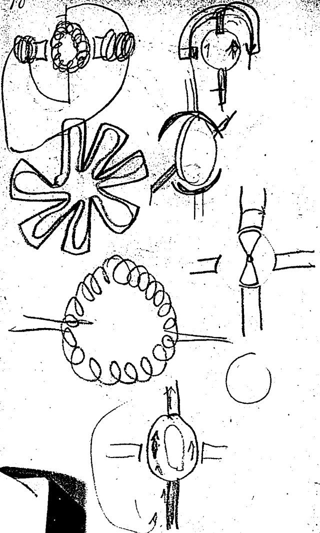
Doubling speeds,
4000,
Siemens

Proportion of resistance
on a machine, where the
~~fraction~~ loss of ~~[illegible]~~ power
is 1/2 in Current & 1/2 in
friction; ~~the~~ or other factor
~~Quadrupling the power gives~~
~~a gain~~ with a Constant
power, we do not gain
anything by making the
resistance of the machine
$\frac{1}{4}$ of the External. but in
a machine where the friction
or other factors absorbs less
power than the Current there
is a gain. up to a certain
point, when loss commences
in a perfect machine this gain
~~gain is infinite [illegible]~~
increase. Without limit
but in a machine that

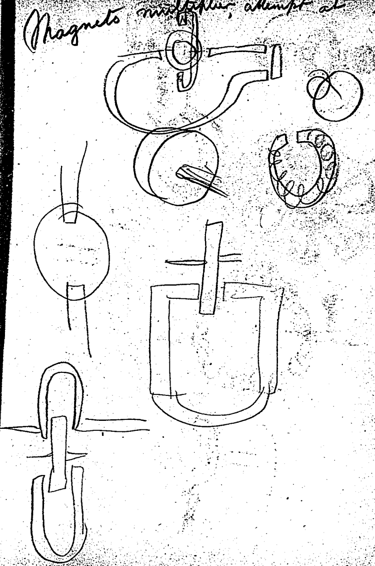
absorbs more power in friction etc than the Current there is a loss by making the external 3/4 & internal 1/4 -

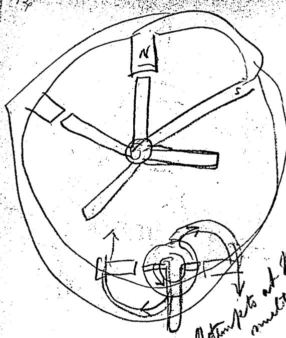
2nd. Law

in any machine, ~~or~~ no matter how ~~p~~ much power is lost by friction etc, Quadrupling the h-p. gives a gain in Current, per h.p. ~~so~~ for the reason that doubling the speed in the case of friction in doubles it while the Current is quadrupled - This takes for granted that the commutator can take off the current as well at high as at low speeds

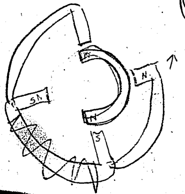


Magnets multiplier, attempt at

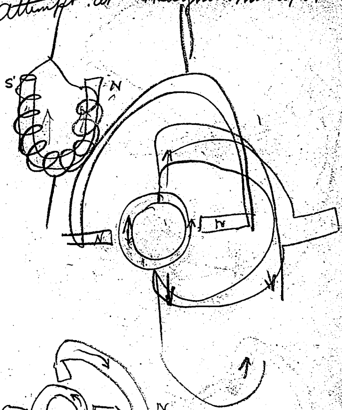


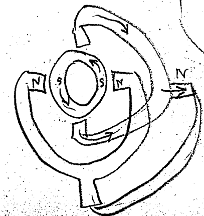


Attempts at Magneto multiplier

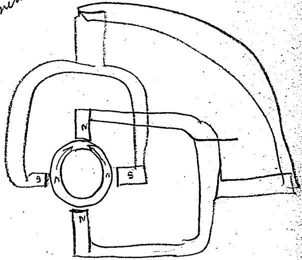


attempt at Magnetomultiplier

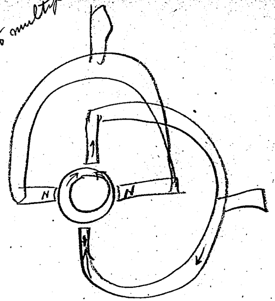




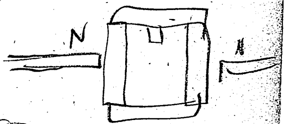
Attempt at
Magneto multiplier

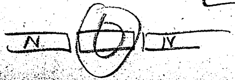


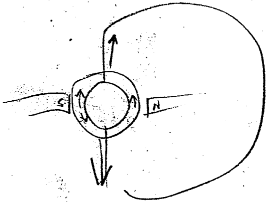
Magneto multiplier



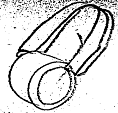
Portland

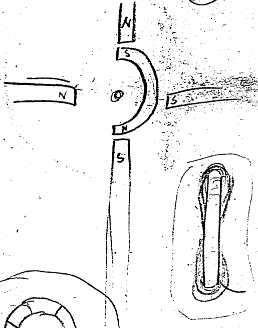


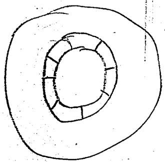


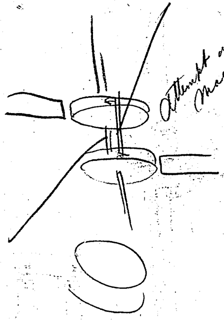


Magneto multiplier, attempt at.



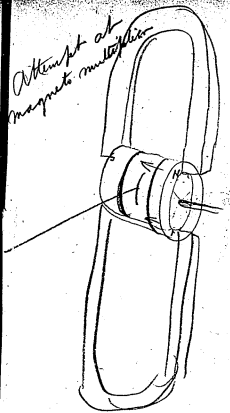


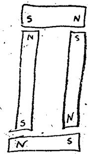


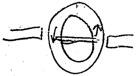


Attempt at magneto multiplier

Attempt at magneto multiplier







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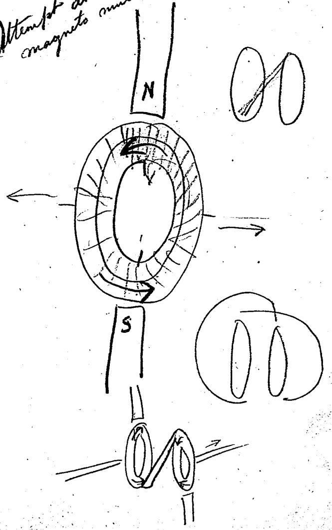

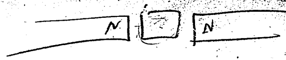

Attempt at
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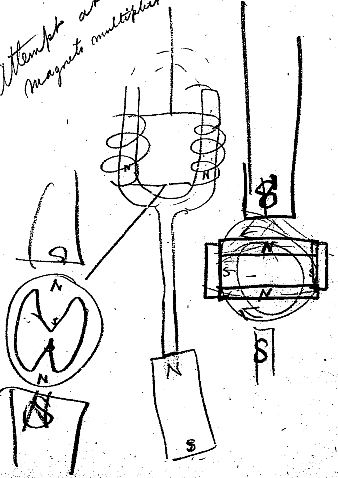

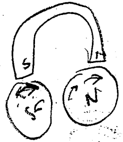

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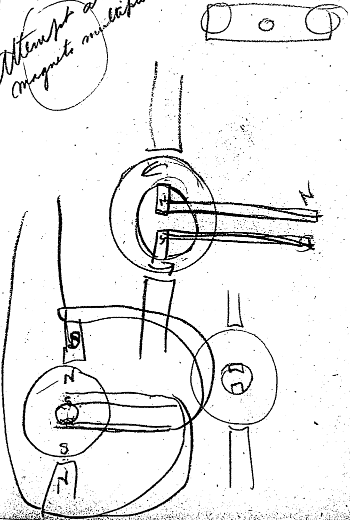


$\bar{2}.0287$
$\bar{1}.7056$
$\bar{3}.7343$

$\bar{3}.4029$
$\bar{1}.0504$
$\bar{4}.4533$

$\bar{3}.5464$
$\bar{1}.4689$
$\bar{3}.0153$

511
414
97

$\bar{3}.7343$
1.0969
$\bar{2}.8312$

$\bar{4}.4533$
1.0414
$\bar{3}.4947$

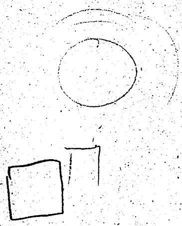
1.0511

116
65
51

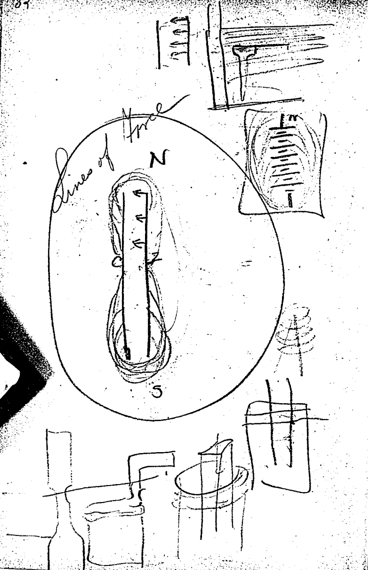
2.5711 372.
2.6022 400.
2.4500 280

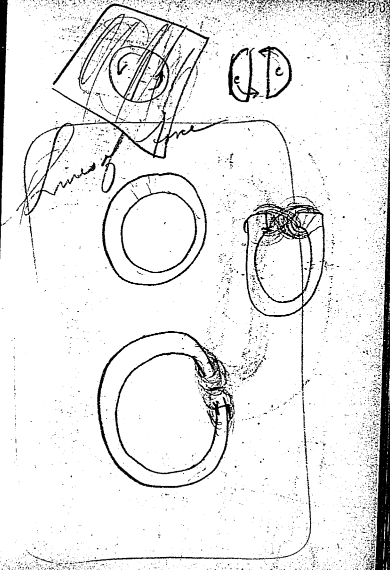
~~1437~~

0.5624

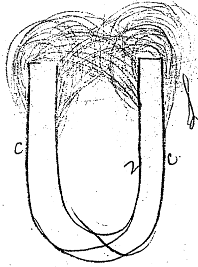


Lines of Force


Lines of force
N
S


Lines of force

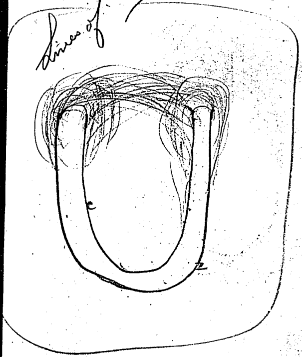
little weaker across than shewn according to distance apart

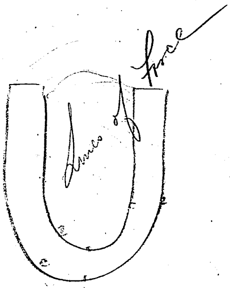


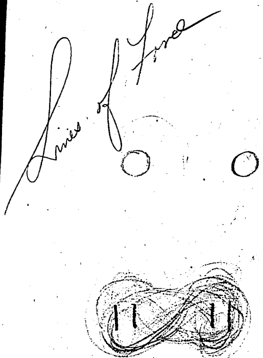
Lines of Force

This

Lines of Force

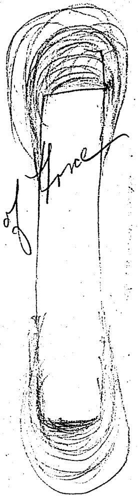



Lines of force


Lines of force

Lines of Force

Lines of Force



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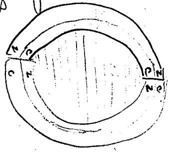
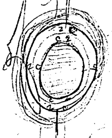
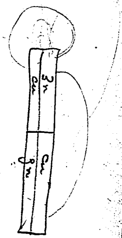
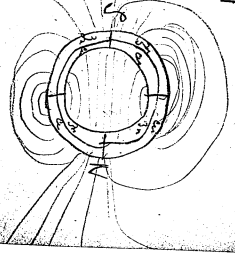
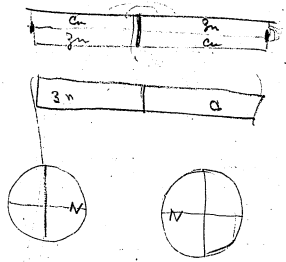


Lines of Force

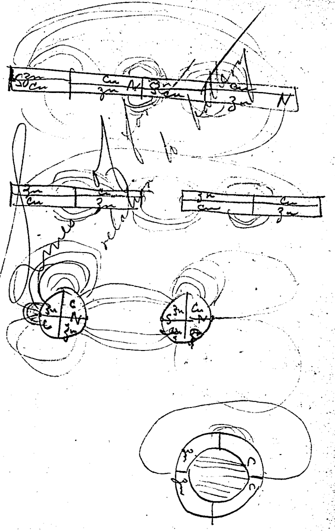


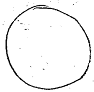


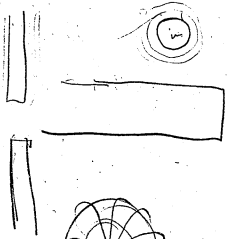


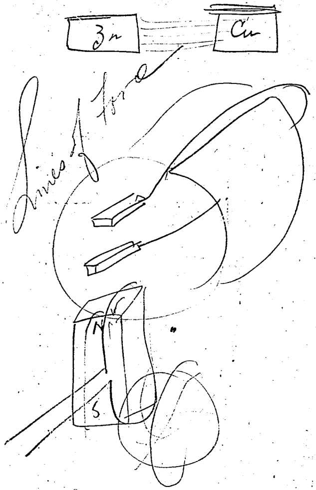


Trying to establish a relation between the magnet and Zn & Cu with currents flowing in a fluid

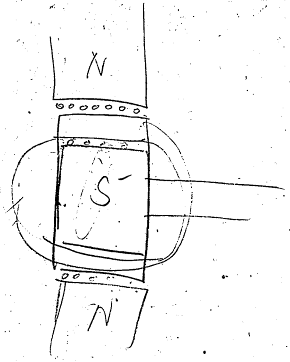


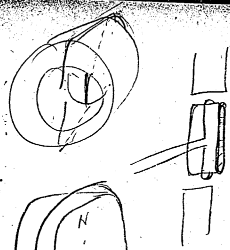



in

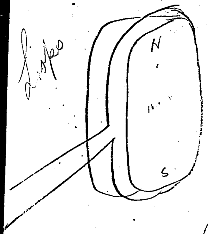

Zn
Cu
Lines of force
N
S

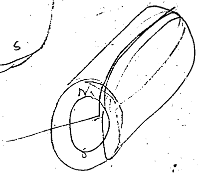
Nitrogen

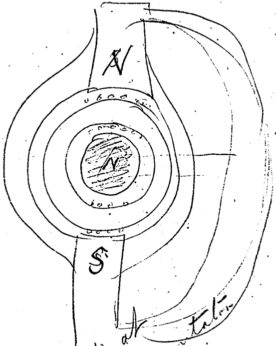




Lippes

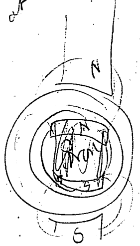


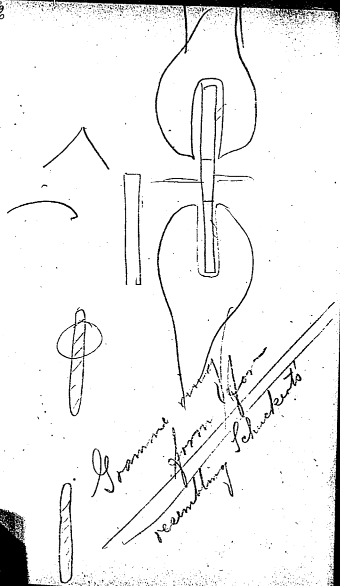




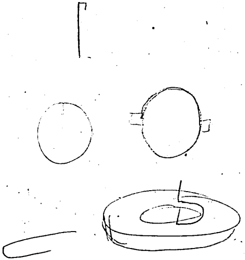
attempt at
non commutator

Attempt at anon commutator

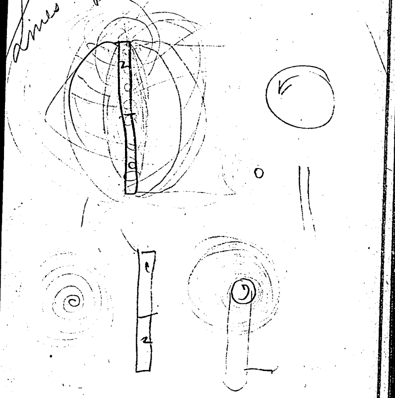




Gramme arm
form for
resembling Schuckerts



Lines of force



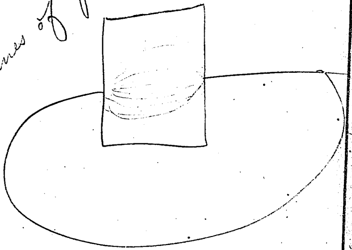
Plant 12.800.

Running Ex. Interest — 1800
Coal 1000
Eng + firemen 1500
accidental 800
incidental 1000
3700 6100

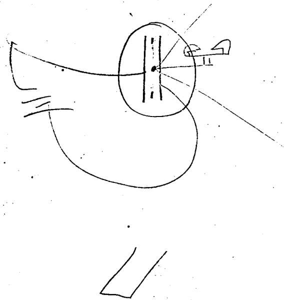
3600
1800
400
500 6100
200
2 10.00,
500
600
500 160
1280 8, 6
950
1800
int — 1050
1500
Coal. 800
300 950
350 12.75.

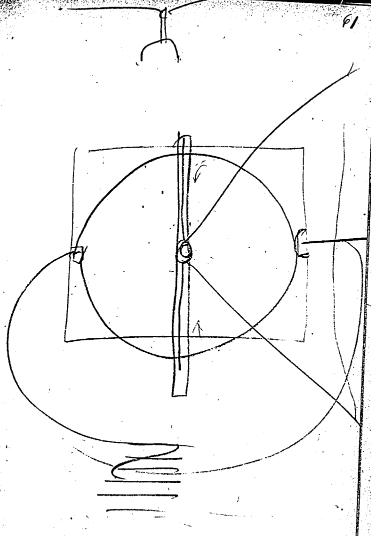
480)6100(12
480
1300
960
340

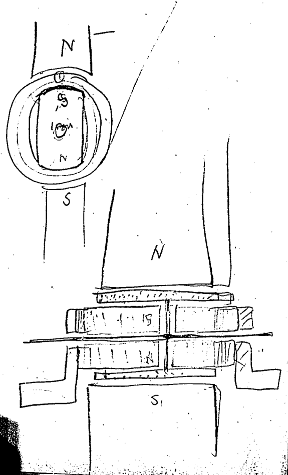
Lines of Force

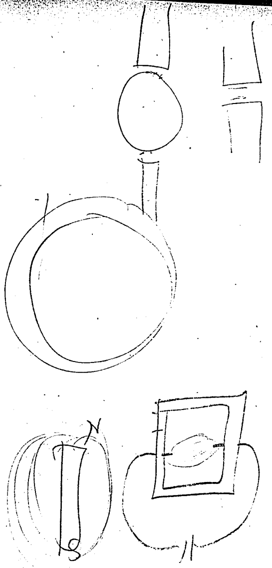


2000.






N
S
S
N
S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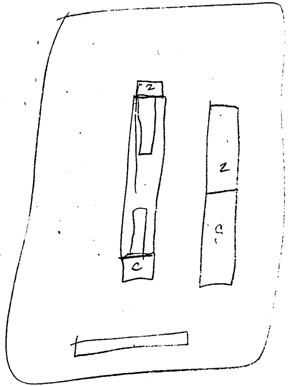
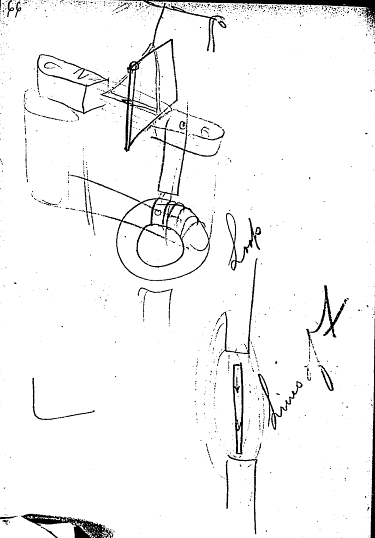
S


z
c
z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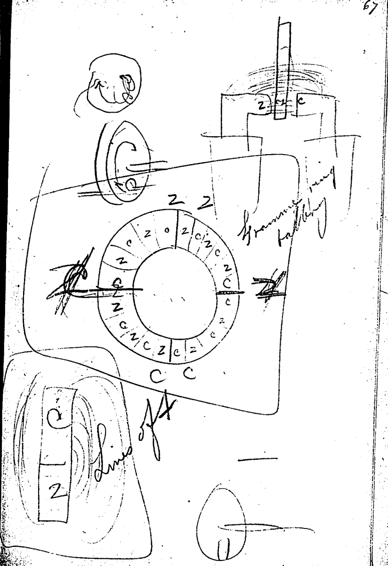

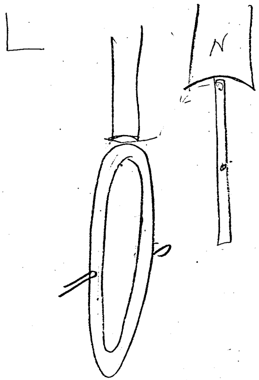
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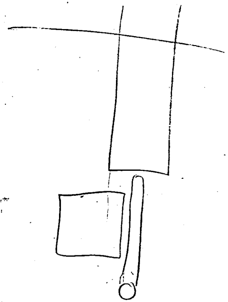
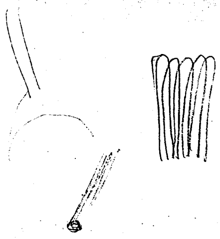
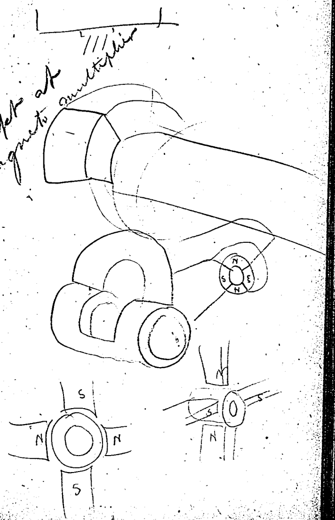
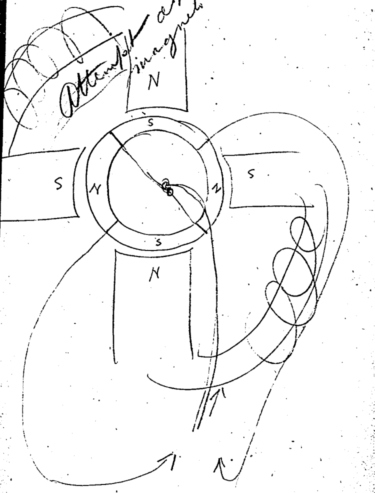


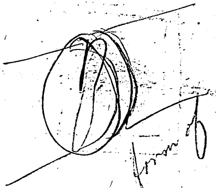


Attempt at magneto multiplier

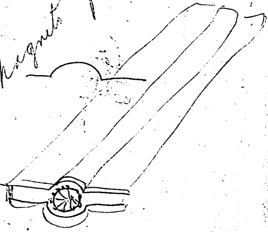


Attempt at magneto multiplier

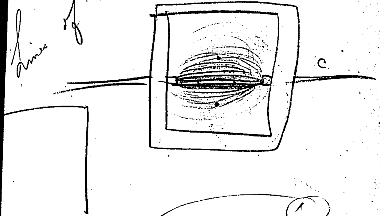


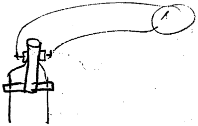


Magnets form of



Lines of F





6
6
36
44
144
144
1584

25
25
125
50
625
44
2500
2500
2500
2750

105) 1584 (15
105
534
525
9

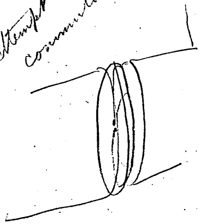
18
18 : 9
$4\frac{1}{2}$

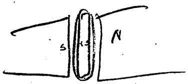
9 75

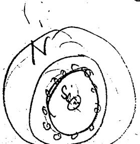
175) 27500 (157
175
1000
875
1250
1225
25

157.

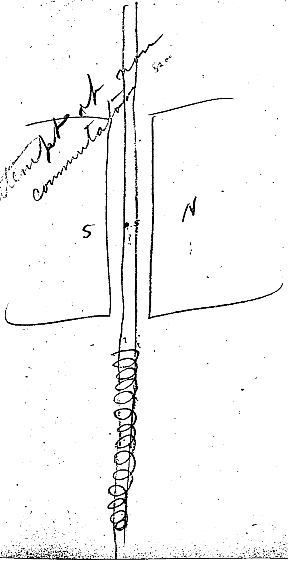
attempt at non commutation



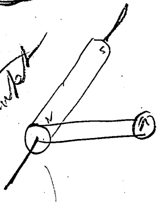


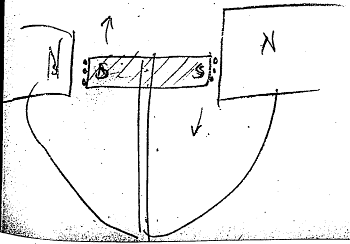


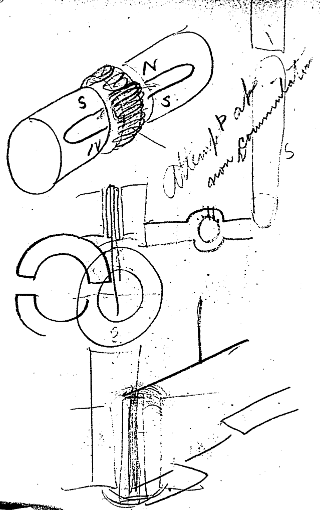
Attempt at new commutator

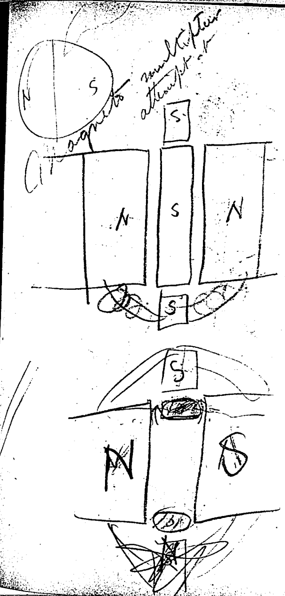


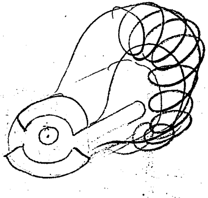
Attempt

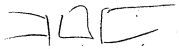




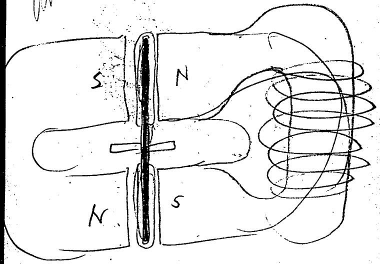

N
S
S
N
Attempt at
non commutation
S
S

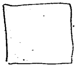

N
S
Magneto multiplier
attempt at
S
N
S
N
S
S
N
S

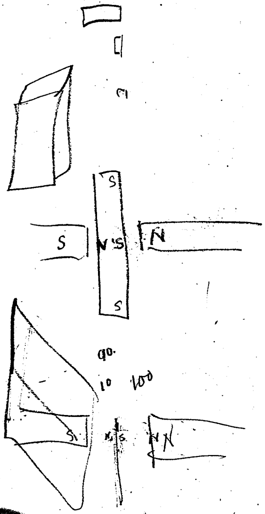




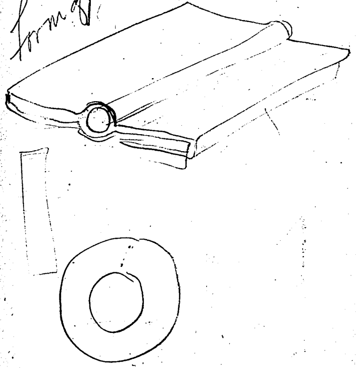
Attempt at magneto

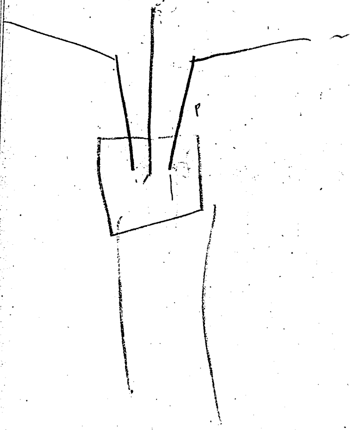


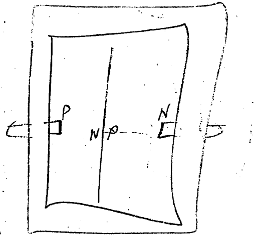




Form of magnet

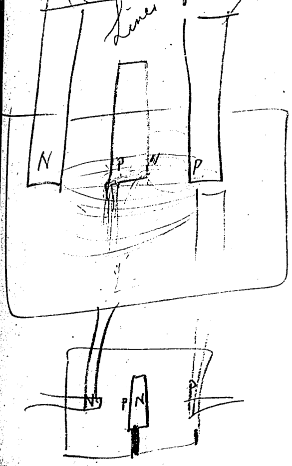



P

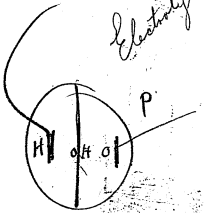

P
N P
N

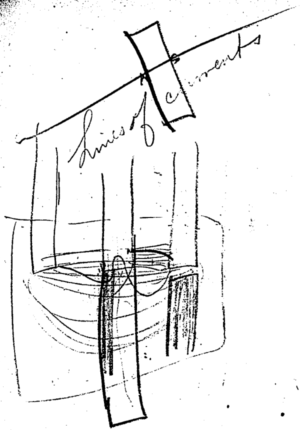
48°

Lines of X

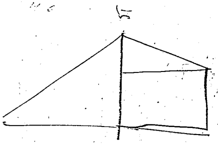


Electrolysis diagram



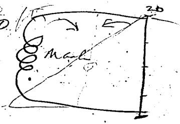


4) 400
46

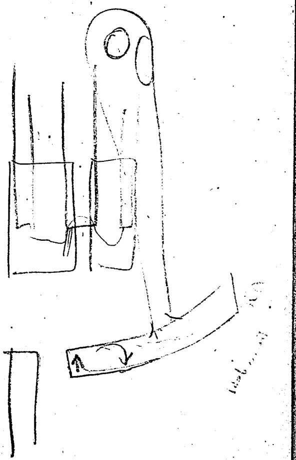


50
1·8
350
40
390

10 ohm



1 ohm



93
3
279

93
93
279
837
8649
44
34596
34596
380556

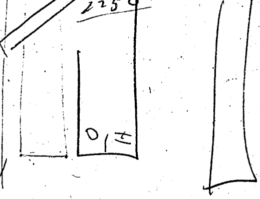
5) 845

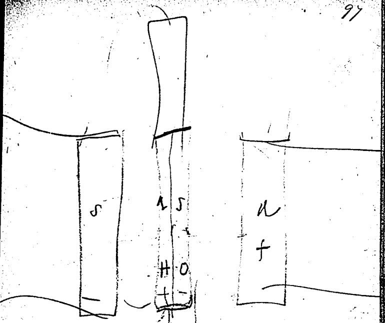
450) 380556
3600
2055
1800
2556
2250

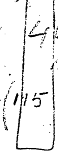
(845

1DOR

Francis Jehl





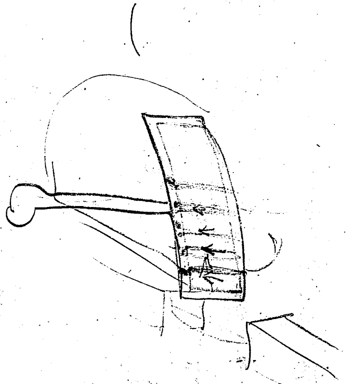


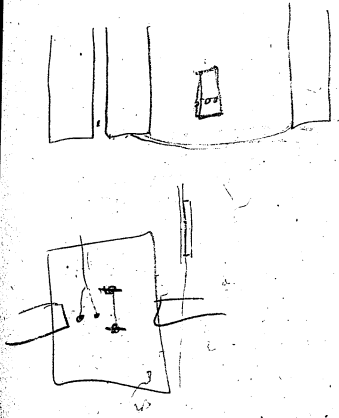
400) 380556 (951
3600
2055
2000
556
400

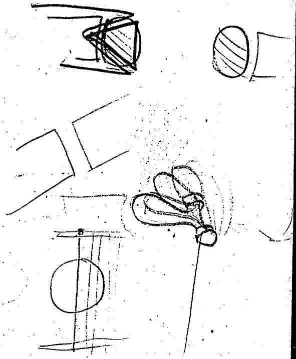
375) 380556 (115
375
555
375
1806
5

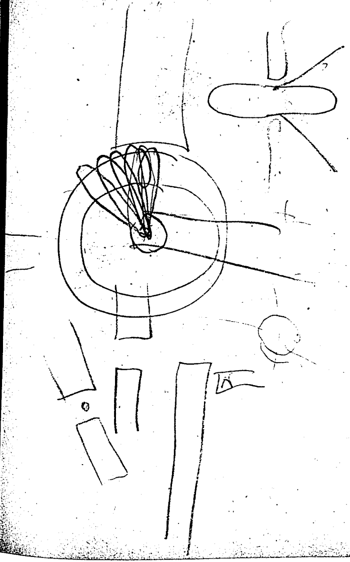
.16.

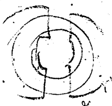
25) 951 (38
75
201
200



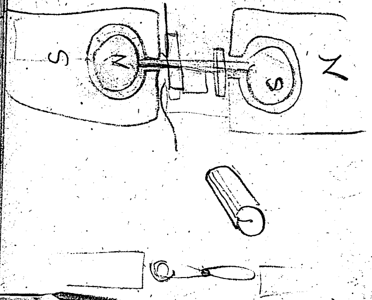


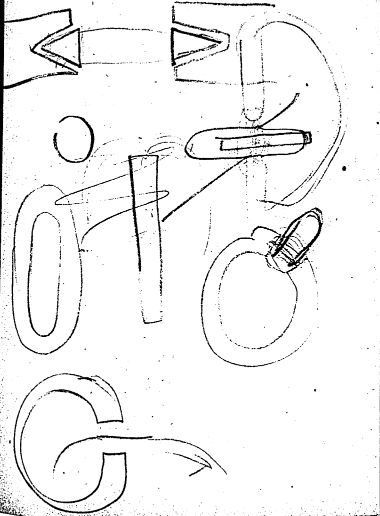


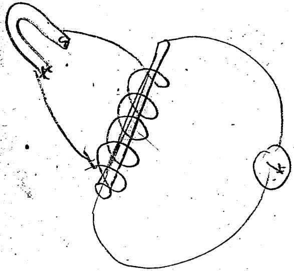


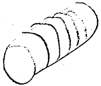


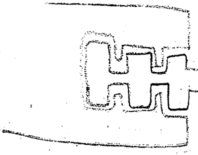
Gramme ring [illegible]

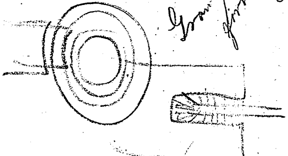


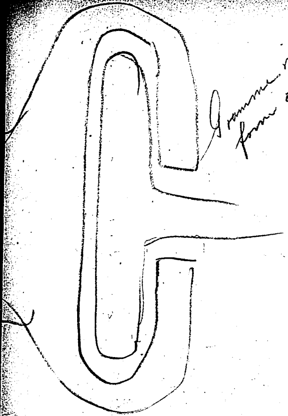




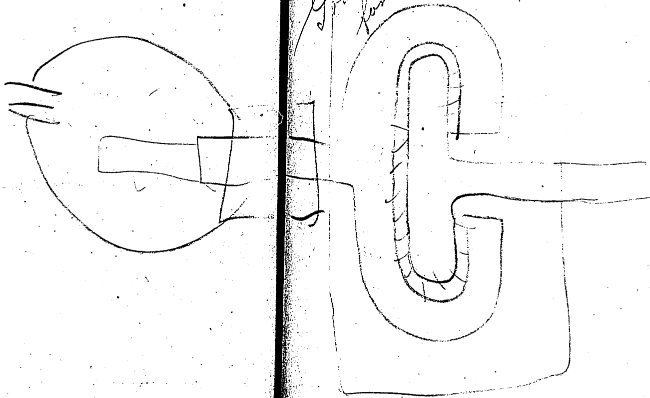



Gramme ring
form of


Gramme ring
form of

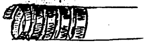

Gramme ring
form of

Gramme ring
form of



Dynamometer

Make Iron spiral of
$\frac{1}{4} \times \frac{1}{8}$ iron. Inside of
hole $\frac{1}{2}$ and about 6 inches



long. Wind wire on small
bobbin & pass through to
wind it round lengthwise

32
32
64
96
1024

2.95
29.5
1475
2655
590
870.25

1024 : 900 :: 99.1 :
900

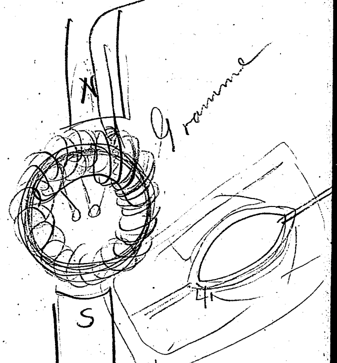
1024) 991×900 (96.8
9216
7030
6144
8860

96.8 feet per Ohm

3.5 feet around

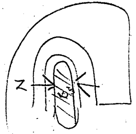
2 ohms 3.5) 193.6 (55.3
175
186
175
110

18) 55.3 (30
54
13



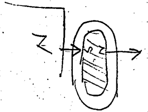
15
3
45,

16,



10

1



15.
6
90.

160.

8.

15
10
150.

1

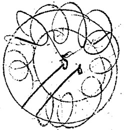
300

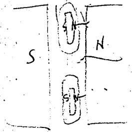
2 foot,

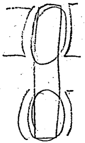
20
6
120,

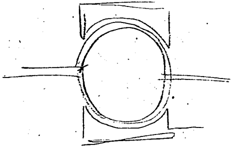
24

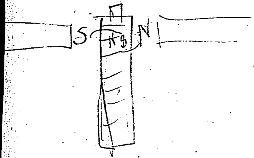
Gramme
opening the ring



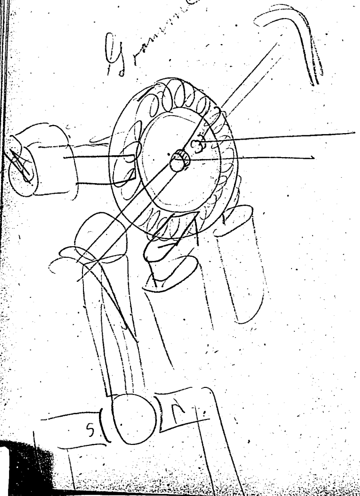


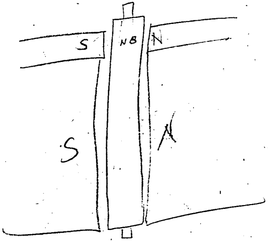


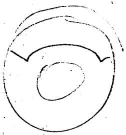


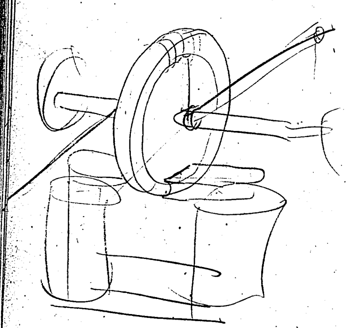


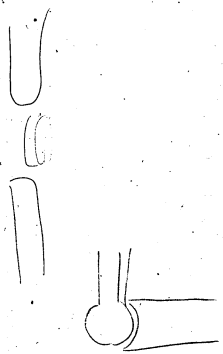
Gramme

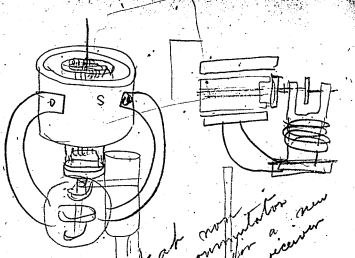






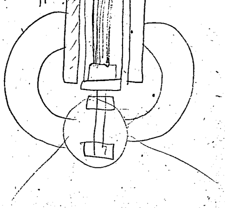




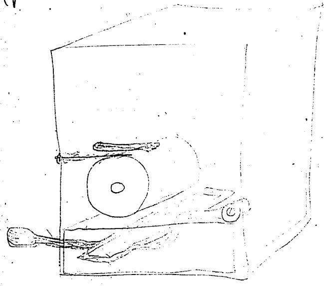


Attempts at magt commutator

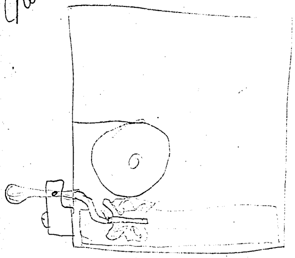
The suggestion for a new telephone receiver



New motograph receiver

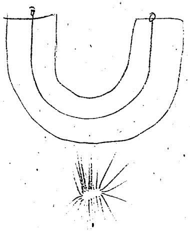


New receiver



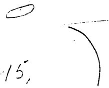
18,

5. .1.



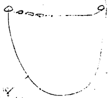
3.

4-7/10. 13 9/10



209.

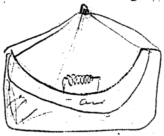
15, 15



15 5

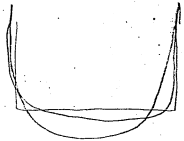
209 210

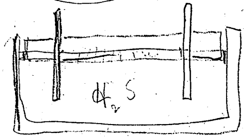
28.

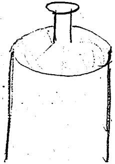


30.

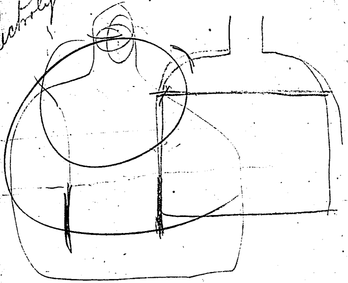
170,

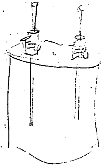






Electrolysis





No. 1 clipped corner

39.150

No. 2 43.200

11–10

5 cells short circuit through the cell plates 1½ in apart

11–37

No. 1 40,950
39,150
1,800

43.200
41.200
2.000

27 minutes

.00326 $\bar{3}.5132$
60 $\bar{1}.7782$
27 1.4314
.7228

5.27 Grammes

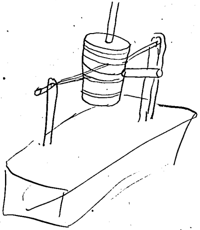
1,80
5.27

.2553 $\frac{1}{3}$

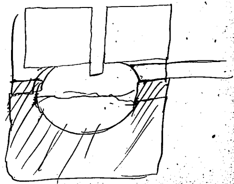
10 volts = EMF

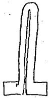
30 Ohms in circuit of!

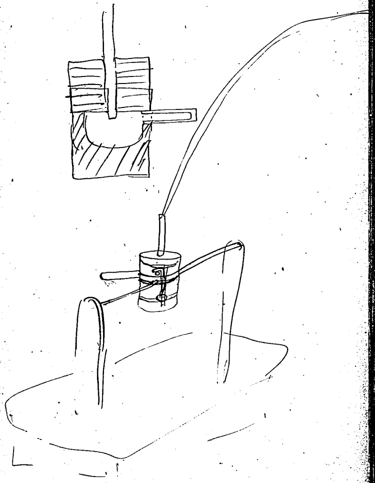
Oxy H. furnace
B

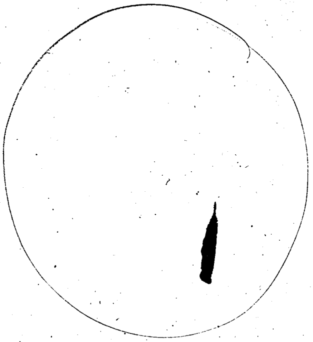


Oxy H. furnace
B.

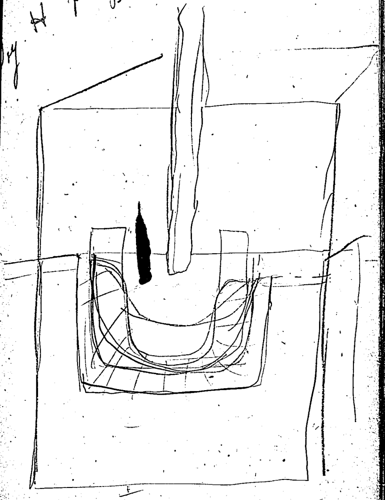








Dry H furnace -
B-

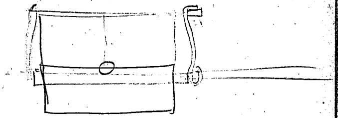


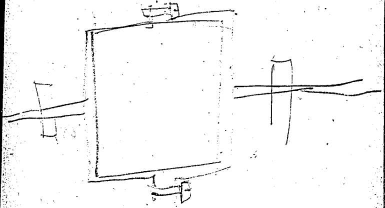
57) 1324.(?)

1050

57) 1172.00

57) 135.00





downstairs

36.2 255.

157. ~~48~~

154
36
193.

85
3
255.

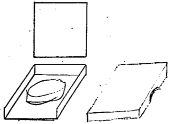
85
85
425
680.
7225
44
28900
28900
31790 | 1647
193
1249
1158
910
772
1380
1351
49.

193) 1647 (
288
1359

193
8
1544.

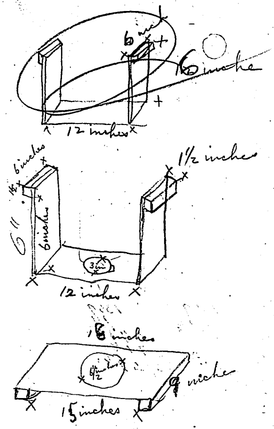
36
8
288

1250
16
7500
1250
20,000.

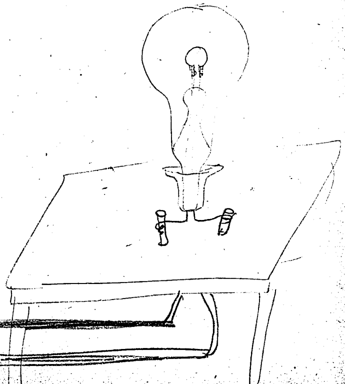


1359
2
2718

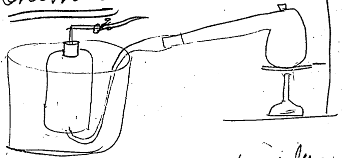
1359
24
5436
2718
32616.



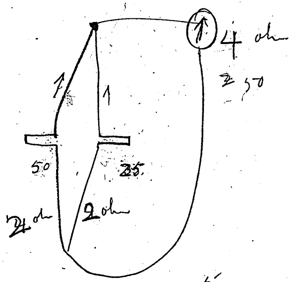
Make a steel wire spiral and dip in Lime solution



Chlorine

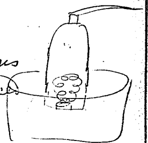


500 grains Black Oxide Man-
4 ℥ (measured) of HCl
~~gentle heat~~
about 5 pints of Chlorine



5'

Nitrogen



Jar of water
Fix piece phosphorus
on porcelain cover fixed
to cork
cover with Bell jar
and the ~~P~~ P combines with O and
leaves N free in jar

250

9 250

$3/4 = .75$

3.14
.75

1570
2198

23550

2.35

235
188

1880
1880
235

441.80

441) 33000 (76.
3087
2130

Wt of tail

5 lbs 10 oz

8.4 Ohms

+ 4 lbs +4 = 12 l 10 oz

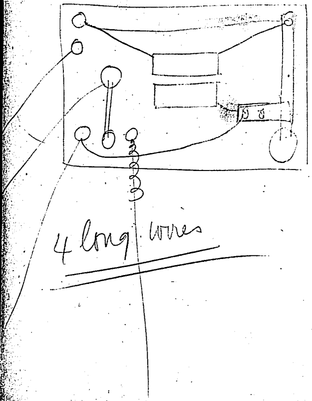
8.7 9.3 ohms

16 lbs 10 oz

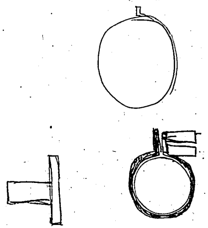
10.5 Ohms

Wt

5 10	
+ 9 ~~lt~~ 5 1/2 oz	9.9 ohms
9, 15 1/2	~~10.7~~
9, 7	16.7 ohms
34. ~~0~~ 6	
34 lbs 6 oz	
9 10	17.2
43 lbs 7	



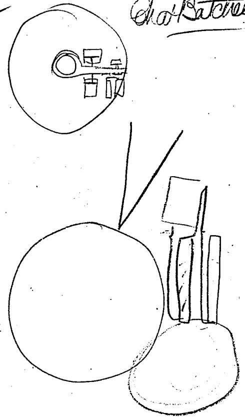
4 long wires



Dynamometer

Mch 20 1879

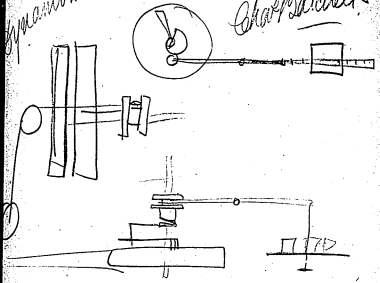
Chas Batchelor



Dynamometer

March 20 1879

Chas Batchelor



log 166 2.2201

	#		
$\bar{1}$.2417	.174	0.8896	7.75
$\bar{1}$.7193	.524	1.1146	13.0
$\bar{1}$.9313	.853	1.3243	21.1
1.0573	11.20	1.9257	84.3
$\bar{1}$.5285	.337	1.1584	14.4
$\bar{1}$.7194	.524	1.2705	18.6
0.8635	7.30	1.8835	76.5
$\bar{2}$.3314	.0214	0.5872	3.81
$\bar{1}$.6671	.464	1.3880	24.4
0.1810	1.51	1.6890	48.9
2.4960	31.30	2.9221	830.5

~~8.33~~

8(3.3) 1.9206

2.001

2.2201

log 83.3 $\bar{1}$.9206

0.2995

$\bar{2}$.9422	.0875	0.5901	3.89
$\bar{1}$.4198	.262	0.8151	6.52
$\bar{1}$.6318	.428	1.0248	10.5
0.7518	5.65	1.6262	
$\bar{1}$.2290	.769	0.8589	7.23
$\bar{1}$.4199	.263	0.9710	9.33
0.5640	3.66	1.5840	38.3
$\bar{2}$.0319	.0108	.2917	1.96
$\bar{1}$.3676	.233	1.0885	12.2
$\bar{1}$.8815	.761	1.3895	24.5
2.1965	15.7	2.6226	41.9

log 3.333 1.5228

2.2201

1.5228

.6873

	#		
$\bar{2}$.6544	.0452	0.2023	1.59
$\bar{1}$.0320	.108	0.5273	3.36
$\bar{1}$.2440	.175	0.6370	4.33
0.3640	2.31	1.2384	17.7
$\bar{2}$.8412	.0694	0.4711	2.95
$\bar{1}$.0321	.108	.5832	3.83
0.1762	1.51	1.1962	15.7
$\bar{3}$.6441	.0044	$\bar{1}$.8939	.783
$\bar{2}$.9798	.0954	0.7007	5.003
$\bar{1}$.4937	.311	1.0017	10.
1.8087	6.44	2.2348	171.

Wt of Pt crucible

~~15.7245~~

15.7245

15.865
15.7245

.1405

Comp .1405 10.8524 -10
.0415 $\bar{2}$.6180
.01116 $\bar{2}$.0473
$\bar{3}$.5177

E. B. .00326
log .00329 .0415 $\bar{2}$.6180
.00329 $\bar{3}$.5177
log 12.6 1.1003
comp 27 8.5686 -10
comp 60 8.2218 -10
$\bar{3}$.8907

.00777 2.1093
128.

Wt of Cu Plate

~~10.4695~~
10 4695
10.511
10 4695
.0415

.01116

comp -10

~~.0471~~

12

1 cell Daniells

Time

9 – 40

Time 10 – 07

27 Minutes

Gramme degree C

1 Gramme = .002204 lb.

---

424 Gramme metre

3.2808 10^3

log	10^3	3.
log	3.2808	0.5159
log	.002204	$\bar{3}$.3434
	60	1.7782
		2.6375

.00336 Zn

log	.00336.	$\bar{3}$.5263
log	60.	1.7782
log	714.	2.8537
log	.002204.	$\bar{3}$.3434
	424	2.6274
	3.2808	0.5159
		2.6449

44.0

10^{10}

10^7

10^3

$C = \frac{E}{R}$ $E^2 = C^2 R$

$E = C R$

$W = C^2 R$

$W = \frac{E^2}{R} = E C$

$W = C^2 R = \frac{E^2}{R} = E C$

$\bar{3}.8593$

log 10^3
log .5159
log .00204

Metre gramme

6375

comp 9.81 9.9083 −10
1.8458

44.2

290
35
330

18 / 290 20

29)36
29
70

(1.

19 / 330 20

33)38
33
50
33
170

(1.1

$g = \frac{E}{R+g}$

$g = \frac{1}{2}\frac{E}{R+\frac{1}{2}g-C}$

$R+g = 2R+g-2C$

$R = 2C$

75

450 H.P. =

1 — 18,−20
45 H.P.

1 = 290 1$\frac{1}{4}$

Resistance 3 cells
Calland through small
plates in bridge 3 Ohms

No. 1 Clipped corner
10.0445
10.094
.0505

No. 2. 10.3673
10.3~~?~~4
.0533

Resistance battery
37° 30'
1.9 Ohm

Time 10-43
1 Daniells through 4.9 Ohms

11-36

11-53
36
17

No. 1 10.094
10.017
.077

No. 2 10.388
314
.074

4.9

$\frac{1}{4.9}$ Weber 9.3098 - 10

.204 Webers

.075 Grammes

17.).075

~~$\bar{1}$.2078~~
~~8.7696~~ - 10
2.0784

.0120 $\bar{2}$.8751
8.7696 - 10

.00441 $\bar{3}$.6447
.204 $\bar{1}$.3098
$\bar{2}$.3349
.0216 1.7782
60.
.000361 4 5567

3.09
2 cells
3.54
3 09
45

45 minutes

$\frac{2}{6.8}$

No. 1 9.816

No. 2 10.575

Zn 65.510 Heat Units
39.415 " "

10017
9816
.201

10575
10388
187

.194

$\frac{2}{6.8}$ Webers

$\frac{1}{3.4}$ $\bar{1}.4685$

.294

.194 $\bar{1}$2878
.294 $\bar{1}$.4685
Comp 60. 8.2218 −10
$\bar{4}$.9781

Comp 45

.194 $\bar{1}$.2878
comp log 294 $\bar{1}$.5315
Comp 160 8.2218 −10
Comp 45. 8.3468 −10
$\bar{4}$.3879

.000244

G mi. deg. C.
733

.003411 10^4

4156

9.81

424 2.6274
9.81 0.9917
3.6191.

4160. Metre gramme
Kilo Metre

$\boxed{10000}$ 10^4

Centimetre 100000
100
1000

$\frac{1}{9.81}$ through a metre

4160 ~~Kilo metres~~

K.M.S

4160 (G M S)

10^4 10^4

100 1000

10^4 C.G.S.

10^4 C.G.

424 Kilo Metres

1 Kilo H_2O 1°C

E = Whole work done in circuit by unit of current in unit of time.

4156.	3.6186	Joules equiv.
10^4	4.	reducing Metre to Cm
734.	2.8657	Zn equiv.
	10.4843	
.003411	$\bar{3}.5330$	Weber equiv.
	8.0173	
	1.041 10^8	Daniells

Page 179

For 45 minutes 2 Daniells cells working on three Ohms outside, inside about 1.9 each Total 6.8 Ohms, deposited .194 grammes of Cu.

comp log	2.2	0.6576	
log	6.8	9.8327	-10
log	.194	$\bar{1}$.2878	
comp log	45	8.3468	-10
comp log	60	8.2218	-10
		26.3465	
		$\bar{4}$.3465	

.000222

log 3.4 .5315

11.24

1 cell Daniells

Now the combustion of .003411 Grm gives out how many foot lbs of energy

1 Gramme burned in battery gives off 714 Grm deg C

425 Metre Gramme

Metre = 3.28 Feet Gramme = .0022 lbs

log	.0003411	$\bar{3}$.5320
Grm deg C	714.	2.8537
Joules Equiv	425.	2.6284.
Feet in M	3.28	0.5159
lbs in Grm	.0022	$\bar{3}$.3424
Sec in min	60.	1.7782
		2.6506

1447

Trowbridge gives the following statement

509,418 Metre Gramme per second

Current 86 Webers
R .675 Ohms

log	509.418	5.7072
log	3.28	0.5159
log	.0022	$\bar{3}$.3424
compl log	86	8.0615 −10
comp log	86	8.0615 − 10
comp log	.675	10.1707 − 10
		29.8592
	.723	$\bar{1}$.8592
log	60	1.7782
		1.6374

43.3 foot lbs per Weber in Ohm

Work $10^3 = \frac{(10^5)^2}{10^7}$

	10^3	3
log	9.81	9.0083 − 10
compl log	60	1.7782
log	3.28	0.5159
log	.002204	$\bar{3}$.3432
log		
	44.2	1.6436

1 Weber equiv. Zn .003411

log	.003411	$\bar{3}$.5330
Favre & Silbermann	714.	2.8537
Joule	425.	2.6288
Feet in Metre	3.28	0.5159
lb in Gramme	.0022	$\bar{3}$.3424
sec in minutes	60	1.7782
		2.6520

448.

1.041 10^8 Daniells

log 10^8
comp log 9.81
comp log 1.041
comp log

$$\mathcal{S} = \frac{\mathcal{L}\,m}{\mathcal{T}^2} \qquad \mathcal{L}^2 m$$

1.4840
1.4840
2.9680
$\bar{2}$.8115
1.7795

9.81

$\bar{1}$.2580
$\bar{1}$.4057
$\bar{2}$.6637

E. G. S.

$$\frac{(10^8)^2}{10^9} = 10^7$$

$\frac{m}{m}$

772

4235.4

m

2 | $\bar{2}$.8115 | 1.4840 $\mathcal{L}$

$\bar{1}$.4057
.7420
0.1477

.7420
3
2.2260
$\bar{1}$.4057
$\mathcal{T}$ 1.6317

$$\frac{\mathcal{L}\,\mathcal{T}^2 m}{\cancel{\mathcal{L}\,\mathcal{T}}}$$

$\cancel{\mathcal{L}^2}$ $\mathcal{L}^2\mathcal{T}^{-3}m$

9.81 | 0 9917
425. | 2 6284
1000 | 3

~~8.6224~~
~~8.6222~~
.6201

~~4 9000000~~

~~41.700000~~

0.9917
2.6284
1000 3

7.6201

981

9.81
425.
1000

~~Dyne~~ $\frac{1}{981}$

Dyne $\frac{1}{981}$

1 Deg. C. Gramme H_2O
425 Metre Grammes
42,500 Centimetre Grammes
981 Erg no C.G.S. in one Gramme Cent.

4.6284
2.9917
7.6201 41,700,000
Erg per gm. degree.

Ohm 10^9
Farad 10^{-1}

10^{-1} G. C. S.

$(10^{-1})^2 \, (10)^9 = 10^7$

10,000,000 Ergs

3

41.560,000 Erg Grm deg C
41,560,000 000 Erg. Kilo. deg. C

$$\begin{array}{r} 9 \\ 2 \\ \hline 18 \end{array}$$

180,000,000

60 minute

10,200,000,000
41,560 000 000

$\mathcal{L}^2 T^{-3} m$

$\mathcal{L}^3 T^{-4} m$

$\mathcal{L}^2 T^{-3} m$

log	41,572,500	7.6185	
complog	.981.	7.0083	−10
Comp log	100	8.	−10
	423.	2.6268	

$\frac{772}{423}$

.009421 Mllgr.

~~oo~~
.0.0.0009421 Grammes

1. Mg = .001 Gramme
.1 = .0001

/

.08771

.0116 Mllgr. H_2O Buff
1 Daniells through Siemens unit Wied Vol III 1059

Comp log .973

Siemens = .973 X
Ohm = 1.0196 X

Siemens = $\frac{.973}{1.0196}$ Ohms

T.9881
.0083
T.9998

log .954 $\bar{2}$.0645

log $\frac{.0116}{1.0196}$ T.9798

.973 -10

$\bar{2}$.0443

.0110 Mllgr Hydrogen evolved from H_2O in one second by a Daniells through one Ohm

.0000121 Grammes

.377 Mllg of Cu deposited in one second by a cell of Daniells through one Siemens
Raoult Wied. 1060

log .377 T.5763
log .954 T.9798
T.5561

.359

.000359 Grammes Cu. 1 Ohm.
for 1 second.

.0116
9
099

00

.000103 Gramme
.103 mg
.0103

Box 8 lbs

D = 38° 30'

6 lbs

D = 56° 30'

8 lbs 59° ~~0~~

10 lbs

Box 8 lbs

28°

12 lbs. 42° 30'

16 lbs. 50° 30'

20 lbs. 54° 30'

24 lbs. 56° 30'

28 lbs. 60°

32 lbs. 61°

36 lbs 63° 30'

40 [illegible]

36 lbs

480 revolutions

36 lbs

61°

3.1415
20 diametre
12 / .6 2.83
5.24

3 Ohms

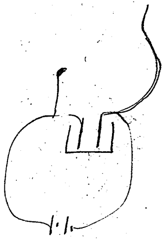
5.24
480
41920
2096
2515.20

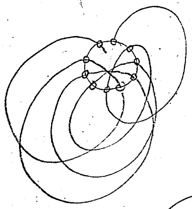
2515
36
15090
7545
33000) 80540 (2.7 H.P
66.000
145400

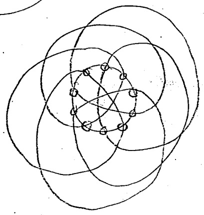
550 3 Ohms

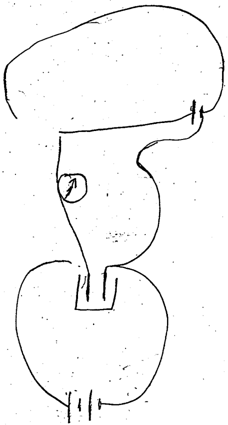
22 lbs 270
540 revolution

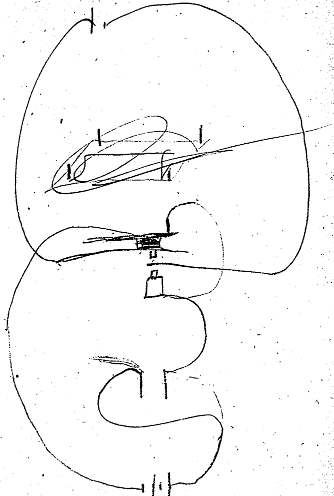
5,24
540
20960
2620
2829,60
22
5658
5658
33000) 62238 (1.8 H.P
33000
292380

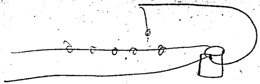










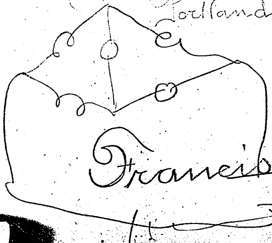


Thursday

Thursday

Portland

Portland



Francis

PH

Frend French

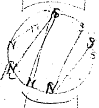
Frendship

Frend

Frendship

French

Frende



French

Francis

Frend

Francis

Francis

Frang

Frangapani

Francis

3000 hp	75,000.
Dinamos —	48,000
Boilers —	45000
feed HO.	10000
25 Piping.	15,000.
Shifting	10,000 -
fitting up.	50,000.
	253,000.

425

Engineers Staff	10,000.
attendants	5,000.
Labor	2500
Coal	35000
365 Oil	3000
Repairs	3000
Extras	3000
	63,500.
Intrst	37,000.
	100,500

365
25
18
730
912

365
30
10950
3
32850

10

75000
100000
45000
10000

16 per year

365
50. daily
18250

11/400
33

18

6000)100000(

4

16

15
6
90.

16
6
96

63000

5)3000
6

600
200
120,000

662
7 756
6 883
5 1059
4 1324
3 1766
2 2649

1059
5
5295

7/5298
756
7
5292 39.

9)5298
588 - 6

78.7

8.83 Cents

8/5298
662 - 2

3. 5)5298
1059 - 3
6

44 5095

4)5298
1324.2
4
5296

1259
5
6295

3)5298
1766
3
5298

1766

2)5298
2649
2
5298

Station plant 300 000
" Expenses 63,000,

18000 lights

18000) 63000 (3.50
54000
9000

3.50 c per year
5.33
8.83

600.000

16
6
96

18000) 96.000 (5.3
90 000
6

No 1 Spiral Mch 19 1879

Time	Cells
10.45	2 cells
	3
	4
10.58	4
11.05	5
11.19	6
11.27	7
	8
11.35	9
11.48	10
	11
11.50	12
	13
11.52	14
11.53	15
11.54	16
11.55	17
11.56	18

Vacuum 1 3/4

11.57 Taken off

No 2 Spiral Mch 19 1879

Time	Cells
1.20	2 cells
	3
	4
1.28	5
1.37	6
1.47	7
	8
	9
	10
1.53	11
	12
2.00	13
	14
2.01	15
2.14	16
~~2.4~~	17
2.7	18

3/4 Vacuum

2.17

2.18 Taken off.

900
90
810,00

6000

74
3000
222,000

174
3

18,000
50
900,000
9

6000

2200) 60000 (27 1/4
4400
16000
15400
600

27
3
81.50

9

5

13650) 18.000 (1
13.650
4350

136 50

18000) 136.500 (.0075
~~126000~~
~~18500~~
126000
10500

1

900
1.0
900.00

136.

900
15
4500
900
13500

H.P.
3000.-

18000 lamps

Daily 10 hours	
Engineers	9.00
Stokers	7.00
assistants	8.00
Inspectors	8.00
Coal 27 1/4 Tons. —	81.50
Extra Coal 3 tons	9.00
Oil	3.00
Waste	1.00
Repairs.	10.00
one day 10 hours	136,50.

3/4 of 1 cent for 10 hours

gas.
18000 burners consume
900.000 feet in 10 hours
which taking the actual cost of producing the ~~light~~ gas at 90 c per 1000 feet,

gas $810.00
Electric. 136.00.

or as compared with Electric Light ~~Electric Light would produce~~ in economy gas must be made for 15 1/8 cents per 1000 feet =

in England the E Light.
worked by.

Engineer.	6.00.
Stokers.	4.00
assistants.	6.00
Inspector	6.00
Coal 27. tons	54.00
Extra " Coal	6.00
Oil.	2.00
Waste	1.00
Repairs	8.00.
	93 00

This brings cost to about $10\frac{1}{2}$
Cents per 1000 feet,

No. 3 Spiral Mon. 19.79

301 —— 2 Cells
308 —— 3
312 —— 4
317 —— 5
331 —— 6
—— 7
3'3.5 —— 8
—— 9
345 —— 10
3.47 —— 11
348 —— 12
348 —— 13
—— 14
—— 15
—— 16
—— 17
—— 18

No 4

2 – 3-50
3 –
4 –
5 – 4.05
6 –
7 –
8 – 4'12
9 –
10 – 4.20
11 –
12 –
13 – 4 38
14

No 5 spiral

4 – 4'40
8 – 5'00

No 6 Spiral Mch 19/79

5.21 — 3 cells
5.28 — 5
5.33 — 7
5.40 — 9
5.46 — 10
5.54 — 12
5.55 — 14
5.55 — 15
5.56
~~5.57 taken off~~

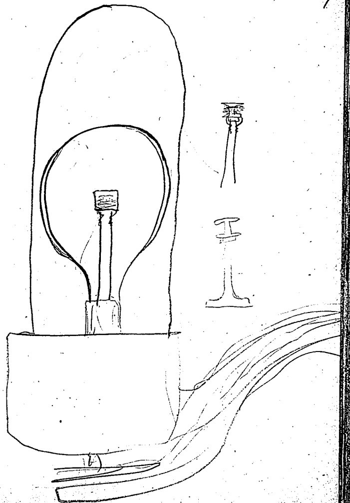
No 1 Spiral Mch 20/79

11.15 — 2 cells
11.30 — 4
11.40 — 6
11.50 — 8
11.53 — 10
11.56 — 12
12 — 14
12.10 — 16
12.15 — 17
12.18 taken off

Vacuum 2

Electric

Mch — 19, 1879



1 1/2 in

15 $\quad$ 12 $\overline{)36}$ 3
15

15
3
45 feet

1 1/2

Gramme Machine on 9 1/2 ohms and Spiral at yellow red 2.20

Dynamometer

Box	2 lbs	10 oz
	2	1 0
	2	8 oz
	7 lbs	14 oz

lbs to balance friction

2 lbs	9° 30'
4 lbs	15° 30'
6	19° 30
8	26°
10	28° 30'
12	29°
14	31°
16	33°
18	35°
20	37°
22	37° 80'

0 = -1

24 40°

26 41° 45'

28 43° 30'

30 lbs 44°

34 lbs 47°

38 lbs 50°

42 lbs

20.

300.

576 | 317900 (567
2880
2990
2880
1100
1158

562

57 | 562

540
55
2700
2700
29700

540
59
4860
2700
31860

540
62
1080
3240
33480

61.

34 lbs

520

3,14
20
12) 62.80
5.23 feet

5.23
520
10460
2615
2719.60 feet
34
10876
8157
92446
33000) 92446 (2
66000

33000) 92217 (2
$\cancel{66}$000
$\cancel{26}$.217

5 - 23

34
5
170
7,82
177.82

.34
23
102
68
7.82

177 .82
520
177
354
885
92217

April 8th 1879

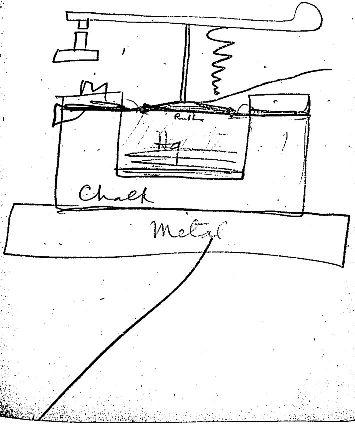
Put on 10-55 a.m. off 12 m. started 1 P.M. off 6 P.M., started 7 P.M. off 10 P.M. 9 hours

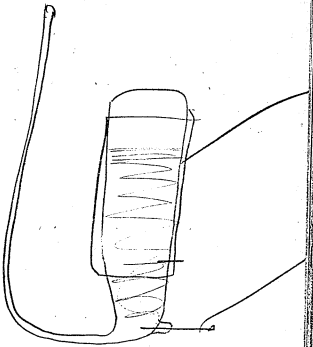
April 9

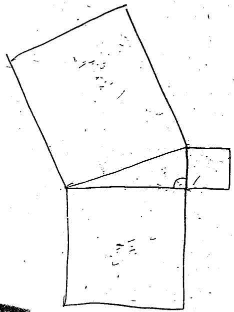
On at 7 a.m. 1/2 of the top layer ~~crossed~~ at 11 a.m. took it off to fix at 11-36 a.m. — The glass was very black, but we found it was due mostly to the hard rubber insulation on the rod which had burned to a crisp. We separated the spirals and put it on 11-58

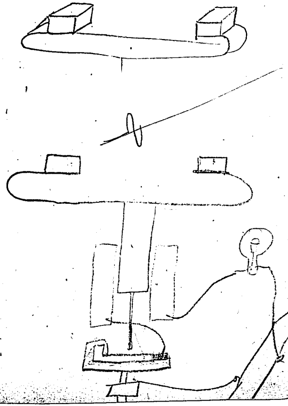
Apr. 9

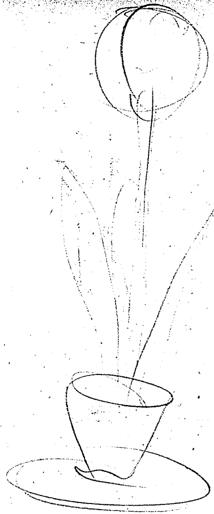
Taken off 12 M
Put on 1 P.M

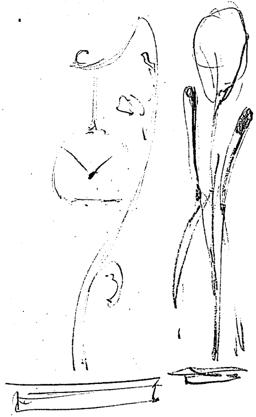


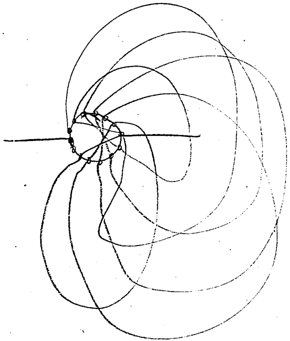


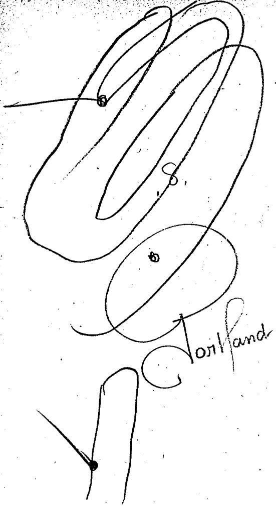


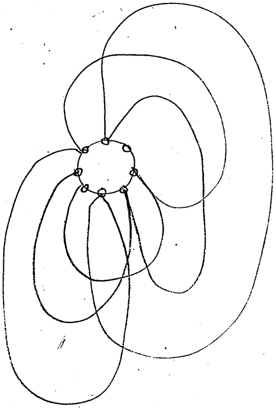


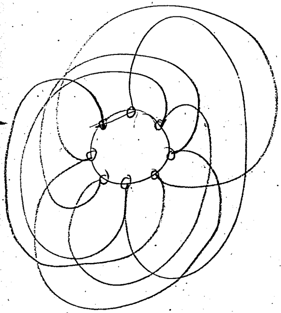


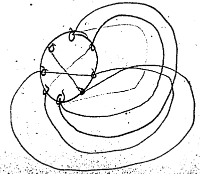


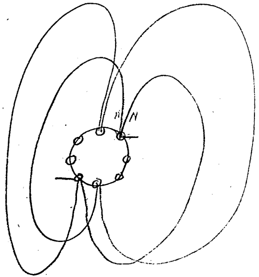



S.
Portland





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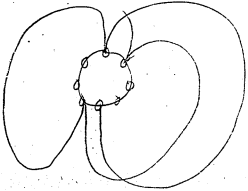


6X6 36

104 ~~c.~~ thems. 2 | 144 4
| 9/1 2 8

820 ohms

10.0° 1820 ohms

Change 10.0° ~~ohms~~. 10 ohm

1.00 differ

16.

2.15 Shunted by 2.15 X 18

2.15 × 18 = 21.20, 215, 41.70

2.15 × 41.7 = 15.05, 2.15, 8.60, 89.655

$$\frac{2.15 \times 41.70}{41.70 + 2.15} = \frac{89.65}{43.85} =$$

4385 | 89.65 | 2.0
87.70
1.950

274° to the right
240° .. .. ..
46° .. .. ..

65° to the left
75° to the right
19° to the right
19° to the left
76° to the left
76° to the right
220° to the right
210° to the left
220° to the right
0°
184° to the right
181° to the left
180° to the left
178° to the left
65° to the left
59° to the right
55° to the left
53° to the right
175° to the right
185° to the right
190° to the right

195° to the right
195° to the left
205° to the right
198° to the left
198° to the left
200° to the left

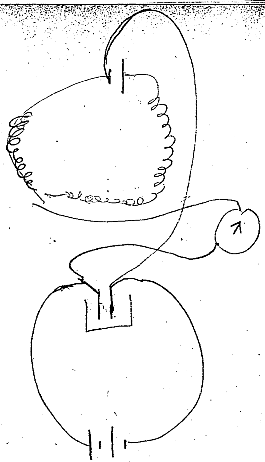
1

85 100 3179.
85
425
680
7225
7 2 44
28900
28900
28900
3179.~~00~~
200) 3179
1589 –

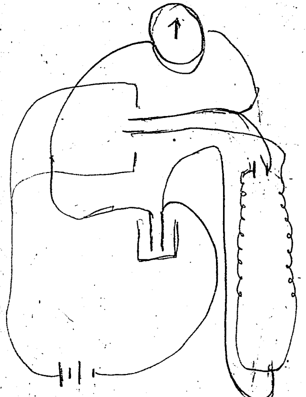
.1

16,

.1



205° to the left	~~70° to the right~~
213° to the right	~~48° to the right~~
205° to the left	~~50° to the right~~
175° to the left	~~25 to the left~~
175° to the right	
203° to the right	
175° to the right	207 to the right
55° to the right	198 to the left
55° to the left	207 to the right
0°	175 to the right
50° to the right	166 to the left
195° to the right	56 to the left
200° to the right	50 to the right
204° to the right	0°
196° to the left	[illegible] to the right
198° to the left	0°
205° to the right	48 to the right
210 to the right	45 to the left
170° to the right	45 to the right
203° to the right	175 to the right
205° to the right	215 to the right
0°	205 to the left
~~60 to the left~~	55 to the right
~~30 to the right~~	60 to the right
~~63 "~~	106 to the right
~~65 "~~	



105 to the left
216° to the right
216 to the left
210 to the left
208 to the left
8°
205° left
210° left

315	left	70	right
310	left	70	"
305		210	" "
0°			
305	left	215°	" "
143	left	221°	
220	left	225°	"
225	left	230°	"
230	right		

		170	right
~~171 left~~		84	"
		85	" "
204	right	20°	
99	right	169°	left
100	right	82	"
204	right	85	" "
		84	"
		80	"
		81	
		85	"
		83	"
		20	

95' right
79 right
95 right
150° right
40 right
69 right
20
85 right
40 right
85 right
45 right
20
40 right
83 right
40 right
75 right
83 right
44 right
40 right
83 right
20

96° right
205' right
20' "

97 right
0°
96 left
90° right
95 left

90 R.
85 L.

124 left
127 right

125 left
122 left
125 right
45 right
90 right
0°
235 right
117 right
115 right

117 R

114 R.
114 L.
114 R
230 R.
228 L
114 R
125 L
124 right

124 R
124 L
228 R
360 R
124 R.
360 R
124 R
240 R
228 R
228 L
115 Left
115 L
114 R

125 R
115 R
125 R
128 R
125 L
126 L
124 L
43 R
43 R
44 R
50 R
55 R
44 R
44 L
90 R
44 R
89 R
124 R
125 R
126 L
44 L
89 L

129 R.
128 R.
129 R.

135 R
131 L.
124 R

2 ~~Volts~~

1 Carbon .1 Ohm inter

1 Thermo $\frac{1}{75}$ Volt

1 Therm $\frac{1}{50}$ Ohms

Magnet .1 Ohm

$\frac{2}{.2} = 10.$ Webers

10 Strength of magnet

$$\frac{\frac{1}{75}}{\frac{1}{50}+\frac{1}{10}} = \frac{\frac{1}{75}}{\frac{6}{50}} = \frac{50}{75 \times 6}$$

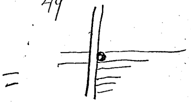
$$= \frac{2}{3 \times 6} = \frac{1}{9}$$

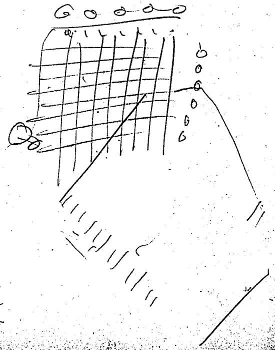
$\frac{1}{9}$ Weber

90 Thermo to equal carbon

111 R.	120R
111 R	228 R oscule
49 R	232R
80 R	228R
75 R	215R
111 R	220R
109 R	214 R
221R	215 R
105 R	220 R
105 R	212 R
107 R	220 R
110 R	218 R
169 R	216 R
199 R	216 R
200R	120R.
199 R	
194 R	
196 R	
195R	
194R	
199R	
194R	

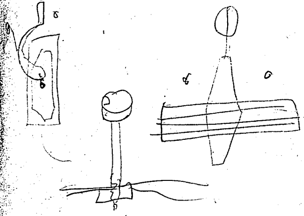
100 L	200 L
95 L	280 L
96 L	~~285 L~~
305 L	0°
0°	49°
85 R	
85 L	
100 L	
102 R	
0°	
85° L	
5° L	
0°	
192 L	
102 R	
0°	
84 L	
308 L	
70 L	
218 L	
210 L	
58 L	
70 L	
210 L	
50 L	
51 L	
300 L	
295 L	
70 L	





$\frac{1}{60}$ Sulphide Cu, marked 1

$\frac{1}{75}$ Double sulphide of Cu and lead



$\frac{1}{50}$ Daniells

.01 = $\frac{1}{100}$ Ohm resistance

How many to give the current of 1 Daniells on .1 Ohm

Daniells $\frac{1}{2.1}$ ~~2~~

Five in series will give $\frac{1}{10}$ Daniells E.M.F also $\frac{1}{10}$ Ohm

$$\frac{\frac{1}{10}}{\frac{2}{10}} = \frac{1}{2} \text{ Weber}$$

4

Magnet 2 Ohms

Daniells 2 Ohm

$\frac{1}{4}$ Weber

Thermo Pile

~~200~~ Thermos 2 Ohms
4 Volts

100 Thermos 1 Ohm

4 Ohms

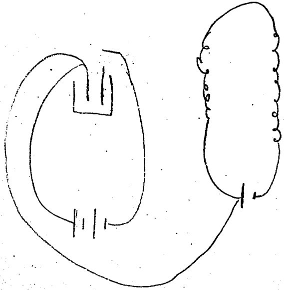
4 1/4

250 R
255 R
220 R
210 R
215 R
230 R
100 R
114.0 R
210 R
124 R
120 R
235 R
230 R
215 R
200 R
156 R
155
~~225~~ R
260 R
250 R

$1 - 1 = 0$

$2 - 1 = 1$

|.	0.
||.	1.
|||.	2.
||||.	3.
|||||	4.



255
36
219

36 : 219 :: 43.9 :
44
876
876
36) 9636 (267
72
243
216
276

267 Ohms

73
73
219
511
5229
8444
21316
21316
234476

267) 234476 (878
2136
2087
1869
218

878) 33000 (36 per H.P.
2634
6660

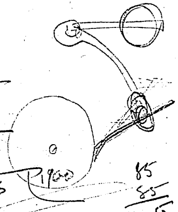
60 : 195 : 90
90
60) 17550
292

267 Ohms
292 Ohms
267
25

257
25
242
25
217

3) 255
85 Volts

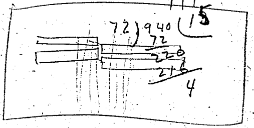
97
97
679
873
9409
44
37636
37636
413996
217
1969
1953



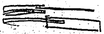
1900

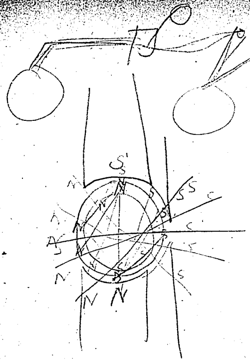
97

85
85
425
680
7225
940
15



72) 940 (13
72
220
216
4

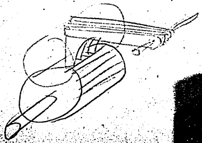




7

6

50



1900) 33000 (

85
85
425
680
7225
44
28900
28900
28900 (1310
242 | 3179
242
759
726
330

13 : 19 :: 10 :
13) 190 (14.6 candles
13
60
52
80

16) 1000 (62
96
40

.15

.062 = 1/16

004
.016

62
62
124
372

16) 3844 (240
32
64
64
0

240

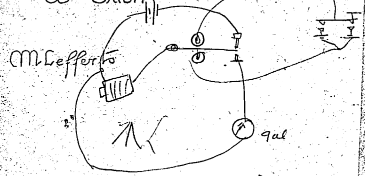
240) 8412 (1.7
240
1720
1680

Wm Orton

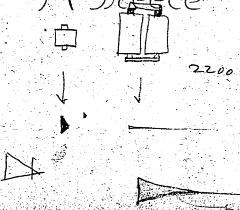
Por Wm Orton. Wm Orton

M Lefferts

Wm Orton



Wm H Preece



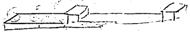
1870 1 7 a Edison

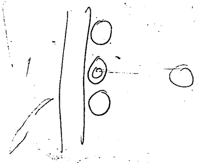
2

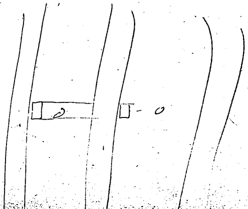
3

4

5







Menlo Park Notebook #48 [N-79-07-05]

This notebook covers the period July 1879-July 1880. Most of the entries are by Francis Upton. Included are notes on motors and "laws of winding motors;" notes, drawings, calculations, and tests of lamps and meters; notes, drawings, and calculations about electric power distribution; and notes on experiments to determine the discharge from a magnet. There are also a few notes by Edison on filament experiments. The label on the front cover is marked "Motors & Meters" and "Upton." The book contains 273 numbered pages followed by 7 unnumbered pages.

Blank pages not filmed: 8-11, 54-55.

Missing page numbers: 17-18.

Cast Iron motors pp 113 - 139 - 141 - 179
Large machine 20 B 124/

Meter p 233 p 103
Grains p 84
Shunts p 213

Experiments to be made T.A.E.

3 Pt Iridium .005 10% to be brought up to one candle or less in the air inclosed in glass and afterwards with the air exhausted.

Carbons to be sealed in 10 small glass globes and 10 very large glass globes carefully measured and dipped then again measured and dipped. Each tried for the whole scale

July 5 1879 TAE 1

put a piece of aluminium in a porous pot with mercury. use carbon in outside cell surrounded with moistened charcoal the water with ~~which it is moistened with~~ ~~to contain~~ a little sulphuric acid sufficient to make it sour have its electromotive force tested =

Melt some nickel in a crucible lined with lime when moltend add 5 per [illegible] its weight of aluminium

[illegible] same

[illegible] of its

Cast Iron motors pp 113 - 139 - 141 - 179
Large machine 20 B 124/1

Meter p 233 p 103
Grains p 84
Shunts p 213

Experiments to be made T.A.

3 Pt Iridium .005 10% to be brought up to one candle or less in the air inclosed in glass and afterwards with the air exhausted.

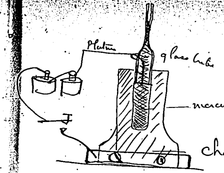
Carbons to be sealed in 10 small glass globes and 10 very large glass globes can

July 5 1879 TAE 1

put a piece of aluminium in a porous pot with mercury. use carbon in outside cell surrounded with moistened charcoal, the water with which it is moistened with to contain a little sulphuric acid sufficent to make it sour have its electromotive force tested =

Melt some nickel in a crucible lined with lime, when moltend add 5 per cent of its weight of aluminium make another button in the same manner adding 4 percent of its weight of magnesium —

July 5 1879 8
TAE



Moisten the charcoal with acidulated water H_2O. SO_3. the platina wire is sealed in the glass tube & a hole made in the charcoal the hole & tube up to the Capillary bore is filled with mercury. the Idea is that on closing the circuit the mercury will rise in the capillary bore;

Machine:

20 inch cylinder as compared to 10 inch

Twice the outside surface

Motors

Theory

May 11, 1880. JFU

Current to regular ·14 Ohm machine think plates

Magnets the same of trans-mitter and reciver

Current passt through a deposi-ting cell and E.M.F measured by means of high resistance Galva. at extremities of the motor at the same time with Elec Dyne in circuit

No. 1 Plate 663.070,
2 509.340

$\frac{48.2 \times 2}{964}$ revo. per minute 3 P.M TAE

High resistance galva. 260
Machine on D = 245
Elec Dyne 1° 45

Motor 964
Driving machine 1100

16

185
2
370
370
4070

16.81
4070
11767
6724
68416.70
2 H.P.

45	.16532
45	1.6532
44	.16464
	4.9538

89900

19

Edison 991 lbs
835
156 lbs

358 P.M.

When Prony from Motor
read: 10 lbs
5.75
15.75 at 11 feet

428 speed of Prony

15.75	1.1973
11	1.0414
428	2.6314
74.200	4.8701
156000	5.1931
	$\bar{1}$.6770

47%

3-45	H.R. 362
	10 lbs Prony
	150 H.R.
346	Started Machine
	19° 45°
3 50	147 H.R
	188 / 2 / 376 Crosby — 1/2 minute Prony

3-36 1135

230 revs Prony
3.51 or 3.52 probably 330 Crosby
10 lbs on Prony

---

500 revs Motor 1/2 minute
322 dyne

500	2.6990
322	2.5079
1.55	.1911

.011363 Grammes ag.
Everett C.G.S.

19010

134.5 2.1287
19010 4.2790
$\bar{3}.8497$
60 1.7782
$\bar{1}.6279$

216 : 134.5 :: .011363

2.1287
Comp 7.6655
$\bar{2}.6554$
60 1.7782
$\bar{1}.6278$ = log .424

J. ~~c = A sin² x~~

$c^2 : c'^2 :: \sin c : \sin c'$

$c^2 = \sin c \dfrac{c'^2}{\sin c'}$

$\sin c = \dfrac{\sin c'}{c'^2} c^2 \qquad c' = 1$

$c : c' :: \sqrt{\sin c} : \sqrt{\sin c'}$

$c = \dfrac{\sqrt{\sin c}}{\sqrt{\sin c'}} \quad \sqrt{\sin c'} = \dfrac{\sqrt{\sin c}}{c}$

Plates

No. 1 659.180
No. 2 513.210

May 12 1880

No 1 646.270
2 512.825

a.m.	
10-5	Started
	1° 30' Elec Dry
	1° 22'
10-14	Stopped

N.J. found a piece of wire in bottom of vessel.

644.230	639.170
514.500	519.710
1158.730	1158.880

644.230	519.710
639.170	514.500
5.060	5.210

5.210
(10 220)
5.135 0.7105

comp. 15 8.8239
comp .0195 11.7100
17.56 Nelson 1.2444

sin 3° 58' 2 | 8.8400
4.4200
1.2444
Constant D.D. 3.1756

Plate 1 644.230
Plate 2 514.500

10-56	4° Started
10 58	4°
11—	4°
	3° 58'
11-11	3 ~~50~~' Stoppe
10.56	
15	Good zero

Plate 1 639.170
2 519.710
Plate

28

$12^{\circ}\ 10'$

(9.3238
4.6619
3.1756
1.4863
1.7752
1.6464
4.9079

30.6 Webers

$\frac{179}{3} = 59.6$

80.900

$c = \frac{E}{r}$

$c^2 R = CE$

10.75	1.0315
436	2.6395
11	1.0414
	4.7124

51.500 ft lbs

436	2.6395
11	1.0414
16.75	1.0315
	4.7724

51.500

2.6395
.1911
2.8306

~~Motor~~
677 revs

29

30 270 on H.R.

Correction
H.R 3 to left when the Pony was taking 10 lbs at 8

64.5 to 69 with 10 lbs at 11 feet

2.3

48 Started

5 lbs at 11

182 L H.R.

$12^{\circ}\ 16'$

150 1.80

$12^{\circ}\ 10'$

637.880
522.380
1160.260

1-31 436 revo

160 H.P.

1-47'-30" Stopped

Leading wires hot machine cool

Cu. Plates gave blackpowder

Plate I: 637.880

Plate II: 522.380

32

15.75 1.1973
441 2.6446
11 1.0414
76.400 4.8831

3 | 195
65-1=64 | 1.8062

23° 37 2 | 9.6027
4.8013
3.1756
42 Webers 1.6257
1.8062
1.6454
119.000 5.0783

1.6257
.13 1.1139
.7396
5.91 Volts
64
5.15
5.915 volts
opposing

4.8851
5.0783
1.8068
Cu. 64%
Bradley
59.7% .0308
1.7760
3. . .
5.07830

3.1756
3.1448
.0308

128000 .0308
5.1091

with E. S. 33

2-15 Started

10

.200 H.R

448 Revs

23° 30'

195 H.R

23° 45

195 H.R

435 revs

10 lbs

448 2.6513

.1911

696 2.8424

comp 1100 6.9586

696 2.8426

89 1.9494

56.3 Volts 1.7506

89

56.3

Whole fm 32.7 active 1.5145

1.5145

1.6464

.2218

78000 4.8972

from a field

56.3 opposing

from current.

59.5 opposing

56.3

59.5

= 115.8

57.9

7½ lbs at 11

270 Volts

3

1215 HR

71.6

17° 2'

215 H.R.

489 Revs

489 2.6893

12.75 1.1055

11 1.0414

68.600 4.8362

5.0919

55.5% 1.7443

17° 2' 2 | 9.4668

4.7334

3.1448

38.7 Webers 1.5886

71.6 volts 1.8549

1.6464

123000 ft. lbs. 5.0919

489 2.6893
.1911
76.0 2.8804

comp 1.100 6.9586
2.8804
1.9494

Speed 61.4 Volts 1.7884

38.7 1.5886
Cold .13 $\bar{1}$.1139
50.4 1.7025

70.6
5.04

Current 65.54 Volts

7½ lbs 2nd time

170 – 260 H.R

17°

160 – 270

270
160
430
215

17° – 25

495 revs

19°

210 HR

482
215

270 H.R

7½ lbs

48	18° 45′
	170 – 25 U
	475 rev
49	17° 12
2-5-0	18° 35′ 468
	205 on H. R.
2-5-1	18° 10′
	205 H. R
	17.

Zero 20′ R

to be added.

 Page 34

~~89.~~
~~57.9~~
~~31.1~~

~~1.4928~~
~~1.4928~~
~~1.16464~~
~~10.7959~~
~~5.4279~~

~~.16~~

~~267000~~

71.6
59.5
12.1

1.0828
1.0828
1.16464
10.7959
4.6079

40.500

59.5 1.7745
12.1 8.9172
5.2996

199.000

The Prony set at 5 lbs and changed as follows without touching

5 1/2 14° 35

6

6 1/2 16°

7 19°

5 minutes about.

5 lbs.

3-~~45~~

3 44-30" 225

~~10~~° 5'

10. 30' 517 ...

225 H.R.

3-46 12°

3-46-30 12° 15'

222 = D H.R.

504

Zero gauge

637.880
522.200
1160080

637.680
519.140
1156820
1160.080
2 / 3.260
1.630
50
1.580

522.200
519.140
3.060
1.630
1.430

1.580 0.1987
Comp .0195 1.7100
Comp 5. 9.3010
16.2 Webers 1.2.097 from Cu cell

2 / 9.3088
4.6544
3.1448
32.3 Webers. 1.5096

637.880
637.680
.160

Plate 1 637.880
Plate 2 522.200 H_2SO_4 in solution
5 lbs

4 - 0' 30"	Started
	11° 32'
	195 H.R.
	550 revo
4 - 2' - 45"	12° 10'
	190 H.R
	539 revo
4 - 3' - 15"	11 - 52'
	185 H. R
4 - 4' - 45"	160
4 - 5' - 30"	325 3/4 minute

Plate 1 637.680
2 519.140

Arranged so as to
throw .25 Ohm into line

4-18"	12°-30' .25 in
	12°-50' .25 out
	no change of 5 lbs.
4-20"	12°-45 .25 in
4 22"	14°.10' .25 out
	498
4-23"	13° .25 in
	472
	1.90 HR

6.75	0.8293
1.1	1.0414
671	2.8267
49,800	4.6974

11° 20

2)9.2934
4.6467
3.1448
1.5019

31.7 Webers
65.6 Volts

1.8169
1.6464

92.300 4.9652

4.6974
4.9652
.7322

54%

31.7

Shunted the magnet of the motor. with 1½ Ohms

260

1 lb on Prony 11 feet

200 H, P

2 min 11° Elec

671 Revs

11° 20

195

.25 Ohm in line

$\frac{198}{60}$

652 revs

80 - 1.79   1.89716.
3.9   0.5911   4.2
20.2 meters   1.3065

2 | 8.9026
4.4513
1.3065
3.1448

Through
5 of 4 boxes each + E.D

4° 35' Elec Dyne

240 H.R. 3.9 Ohms

245 H.R around boxes

3 L

Results

Prony 47% of Edison
74,200 ft lbs out of 156 000 ft lbs

	119,000	Cu	64%
10 lbs 44[illegible]	128000	Bradley	59.7%
	76,400	Prony	

123,000	Bradley	55.5%
68,600	Prony	

Magnet shunted

92,300	Bradley	54%
49,800	Prony	

May 14

Plate 1 630·300
2 512·770

freshly cleaned

To try motor with a meter
8–11 Ohms in spool
around ·1 and ·12 shunt
of very large wire

Plate	11	36·990
	12	37·0575
	13	40·3563
	14	36·751
		151·1548
		151·4457
		0·091

a.m.

8-45 Plates put in the solutions

9-35 65R = D from 20 cells
65L = " " "
with current on line
E.M.F 155—170 R
153—1 L

5° 30' Elec Dyne

112-118.5 = D

9-45 5° 25'
111-122 = D
on 1.98 ohms

115-125 when
first put on
42

60

11 36.990
36.877
.113

37.0575
12 36.916
.1415

12 40.4642
40.3563
.1079

14 36.8~~88~~5
36.751
.1373

.1415
.1375
.2790
.1395 12 & 14

.113
.1079
.2209
.1104 11 & 13

11.976
.1395
85.8 Ratio

1.0780
$\bar{1}$.1446
1.9334 12 & 14

11.976
.1104
108 Ratio

1.0780
$\bar{1}$.0429
2.0351 11 & 13

61

May 14

a.m.

9-53 Started

54 109-119

5°-7'

Temp battery 60° F
depository 62° F

20 cell 347
Battery 4 day old

~~8 cells 334 R~~

.80 = D around 10-11

10-16 in with plates 12 & 14

114.5
2 | 38.2
1.9.1 Webers from resistance

2 | 8.9403
4.4701
19.1 1.2810
3.1891

112
2 | 37.3
18.7

8.8914
4.4457
1.2430
3.2627

May 14

10-8	4° 44'
10-8	334 R 8 cells
	60 R
	Zero 1 G R
10-10	4° 30'
10-12	74 on 10.8 Ohm
	plates 12 b14
10-14	5°
	20 cells 655
10-15	Elec dyne 5°
	108.4 116 HR.

$\frac{246}{4 \times 1.079}$

2.3909
9.3979
9.9678

57 1.7558

8.2442
115.5 2.0626
2.02 Volts .3068
10.8 -1.6334
$\bar{1}$.2734

187 Weber $\bar{1}$.2734
37 1.5682
19.5 1.2900

135 2.1316

May 14

10-16 5° 4'

10-17 108 - 119 HR

10-19 5° 4

110 - 119

~~4 cells~~

10-20 5° 4'

4 cells = 247 R

D around 10.8 Ohm
in with Rotes 12 & 14

112 - 121

66

114.5 ; 23 ;; 2 : x

2

46 1.6628

114.5 2.0588

$\bar{1}$.6040

.4 Ohm resistance of large depositing cell

.an 167

116.5 ; 167 ;; 10.8 : x

1.0334

2.2227

$\bar{1}$.9336

1.2877

19.4

10.8

8.6 ohms the two about

May 14 67

10-23 around 10.8 and

Two depositing cells

160-174 R

10-24 5° 4'

10-25 94-87 L

95-88. around 10.7 ohms

10-27 5° 4'

20 cells 65 R

10-28 D. around depositing cells

23

10-29 180-117 around

5° 10' 2 Ohms

.0648 $\bar{2}.8116$
4.5 0.6532
$\bar{1}.4648$

.291

.648 $\bar{2}.8116$
.648
.7128

630.300
512.770
1143.070
1139.004
4.066

630.300
616.291
14.009

522.713
512.770
9.943
14.009
23.952
11.976

11976 4.0780
comp 35 8.4559
comp 19.5 8.7100
1.2439

17.5 Webers

9 53
10-30
37

May 14

Stopped

Zero E.D. good

Plate 1 616 grammes 4.5 grams
2 526 grammes 11 grams

— 616.291 cut ends of plates
522.713
1139004

Plate 11 36.877
12 36.916
13 40.464 2
14 36.885
151.1457

19.1 Webers calculating from the resistance

17.5 Webers calculating from the Cu. deposited on the plates in the main line

The plates on the shunts took $\frac{1}{88.8}$ & $\frac{1}{108}$ of the current circulating

Motor running free

939 Motor revs.
633 Prony revs.
940 Motor revs.

1° 50'
157 H.R

1.5

72

Neolo May 14 73

11-50 | 260 H.P. TAE

12.5" Lbs at 11 feet
on Prony

165 H.P.
189 revo.

34°

1 ft. 11 inches Radius
46 " diameter

144

15.06
30.12 96

Prony right

74 .0648

$\frac{1}{2}$ .8116
0.6532
.14648

.291

.0648
.1944
.0648
.2592
.1296
.3888
.0648
.4536

541.291
460.194
1001485

447.032
480.389
927421

442.259
469.453
911.712

May 15 75

Standard cells

185 R   190 L
184 R   189 L
184 R   Very good
185 R
185 R

11. A.M.

No. 1 541 grammes 4.5 grains
2 460.194 3
3 447.032 .5
4 480.389 7
5 442.259 4.
6 469.453 8.
7

19.830
19.7805
2 .0495 loss

14.322
14.287
.0350 gain
.0072
.0422

9.761 .9894
.10422 $\bar{2}$.6253
232 2.3641

20.1467
20.097
.0497
.0335
2)1.0832
1 .0416 234

.9894
$\bar{2}$.6191
2.3703

May 15

Lawson Meters
Cu. sulphate with H_2SO_4

1 18.8605 .05 Ohm shunt
20.1467
39.0072
TWE

2 19.830
14.287 .05 Ohm Shunt
34.117

1 18.894
20.097
39.991

18.894
18.8605
.0335
.0081
.0416

2 19.7805
14.322
34.1025

39.0072
39.991
2)1.0162
.0081

34.117
34.1025
2).0145
.0072

1-57	Started TAE
	Plates 5 & 6 in main current
	Plates 1 & 2 H_2SO_4 & $CuSO_3$
	Plate 3 & 4 in saturated Cu
2^0 2'	2^0 30'
	80 & 84 on 1.95 Ohms
2^0 9'	2^0 38'
2-32	Stopped

.0648
9.5
.615

$\bar{2}.8116$
.9777
$\bar{1}.7893$

$\bar{2}.8116$
.1761
$\bar{2}.4877$

13
$\bar{2}.8116$
1.1139
.9255

.0648
5
.3240
.648
.3888

.842
.648
.7872

(1,2) 535.615
465.842
1001.457
1011.485
.028
.014

(3,4) 451.097
476.324
927.421
0

(5,6) 451.787
459.389
911.176
911.712
.536
1268

(1) 541.291
535.615
5.676

(3) 451.097
447.032
4.065

(5) 451.787
442.259
9.528

(2) 465.842
460.194
5.648
.014
5.662
4.065
9.727

(4) 480.389
476.324
4.065

(6) 469.453
459.389
10.064
.268
9.796
9.727
.069

9.796
9.727
2 | 19.523
9.761

May 15.

Grammes

Plate 1	535.615	9.5	grains
2	465.842	13.	
3	451.097	1.5	
4	476.324	5.	
5	451.787	12.	
6	459.389	6.	

TKE

11	36.972
12	36.840
13	40.3747
14	36.970
	151.1567

12
36.916
36.840
.076

11
36.972
36.877
.095

14
36.970
36.8885
.0815
.076
2 | .1575
.0787

13
40.4642
40.3747
.0895
.095
.1845
.0922

9.806	0.9912
.0787	$\bar{2}$.8960
124.	2.0952

9.806	0.9912
.10922	$\bar{2}$.9647
106	2.0265

17 Webers

86.8 Ratio 106. Webers

1.08. Ratio 124.

86.8 : 106 :: 108

2.0265
2.0334
.86615
132 2.7214

9.806	0.9912
comp 35	8.4559
comp 19.5	8.7100
	8.1571
	3.
14.3 Webers	1.1571

	2|.0648
.5	.0324
	.0324
1	.0648
	.0324
1.5	.0972
	.0324
2	.1296
	.0324
2.5	.1620
	.0324
3	.1944
	.0324
3.5	.2268
	.0324
4	.2592
	.0324
4.5	.2916
	.0324
5	.3240
	.0324
5.5	.3564
	.0324
6	.3888
	.0324
6.5	.4212
	0324
7	4536
	0324
7.5	.4860
	.0324
8	.5184
	.0324
8.5	.5508
	.0324
	.5832

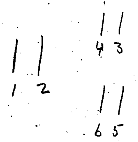
	.5822
	.0324
9.5	6156
	0324
10	.6480
	0324
10.5	6804
	.0324
11	7128
	0324
11.5	7452
	324
12	7776
	324
12.5	8100
	324
13	8424
	324
13.5	8748
	324
14	9072
	324
14.5	9396
	324
15	9720
	324
	10.044

Monday May 17 1880

Meter experiments
Large plates with bending post

No.	Grammes	
1.	509.940	14.5 grains
2.	436.	
3.	433.842	13.
4.	447.713	11.
5.	435.842	13.
6.	441.778	12

TAE



Plates 9.5" X 5.5"

9.5 .9777
5.5 .7404
52.2 sq in 1.7181

May 17

2-17	Started
2-19	5° 48'
2-22	125 on H. R around 2 ohms +
	240 Total ?
2-27	5° 30'
2-31	4° 45'
	118 on H. R
2-33	5°
2-55	4° 45
2-59	120 — 114 Left H. R.
3-2	Stopped 3° 45'
	D = 185 - 100

88 After Before

After	Before
492.324	509.940
452.486	436.
944.810	945 940
	944.810
	2) 1.130
	.565

509.940
492.324
17.616
.565
17.051 loss

442.810	433.842
438.130	447.713
880.940	881.555
	880.940
	2) .615
	.307

442.810
433.842
8.968
.307
9.275 gain

443.907	435.842
433.097	441.778
877.004	877.620
	.604
	.616
	308

443.907
435.842
8.065
308
8.373 gain
9.275
17.648

May 17 89

TAE

Plates	Grammes	grains
1	492.324	.5
2	452.486	7.5
3	442.810	12.5
4	438.130	2.
5	443.907	14.
6	433.097	1.5

11	37.122
12	36.6675
13	40.231
14	37.468

Lamme's plates put the the wrong way to the current

comts	17.648	1.2492
	.0195	11.7100
comp	45.	8 3468
	202 Webers	1.3060

(11&13)
37.122
40.231
77.353
77.3467
.0063 .0031

(11&12)
36.972
40.3747
77.3467

37.122
36.972
.150
003
.153

(12&14) 36.6675
37.1468
73.8143
810
.0043
.0021

(12&14)
36.840
36.970
73.810

36.840
36.6675
.1725
.0021
.1746

17.648 1.2492
.153 $\bar{1}$.1847
(11&13) 116 . 2.0645

.1746 1.2492
$\bar{1}$.2420
(12&14) 10.1 2.0072

May 17

Strip of German silver
w.c. .009 in thick 1/4 in wide
3' 10" long .2 Ohm resistance
4 | 46" long
11.5 long .05 Ohm

1/2 inch wide 1 foot long
.025 Ohm
1 inch wide 2 feet long

May 17 Results

430.930
383.777
814707
813.501
1.206
.603

402.886
410.615
813501

430.930
402.886
28.144
.603
27.541

435.077
381.065
816.142
815.777
2 .365
.182

423.583
392.194
815777

435.077
423.583
11.494
.182
11.312

396.609
425.706
822315
821.971
.344
.172

412.842
409.129
821971

425.706
409.129
16.577
.172
16405
11.312
27.715

May 18 TOR

Plate	Grammes	Grains
1	430.930.	14.4
2	383.777	12.
3	435.077	1.2
4	381.065	1.
5	396.609	9.4
6	425.706	11.4
1	402.886	13.7
2	410.615	9.5
3	423.583	9
4	392.194	3
5	412.842	13
6	409.129	2

(1)

20.1613	38.6835
20.012	38.657
.1493	1.0265
.0132	.0132
.1361	

(2)

19.8478	33.7943
19.7105	33.7670
.1373	2).0273
.0136	.0136
.1237	

(3)

16.819	33.8482
16.7022	33.835
.1166	1.0132
.0066	.0066
.1234	

(5)

18.4005	38.6703
18.273	38.6555
.1275	1.0148
~~.0074~~	.0074
.1349	

Lawson's plates
Cu Shunt .05 Ohm

1	20.1613	20.012
	18.5222	18.645
	38.6835	38.657
2	19.8478	19.7105
	13.9465	14.0565
	33.7943	33.7670
3	16.7022	16.819
	17.146	17.016
	33.8482	33.835
4	18.273	18.4005
	20.3973	20.255
	38.6703	38.6535

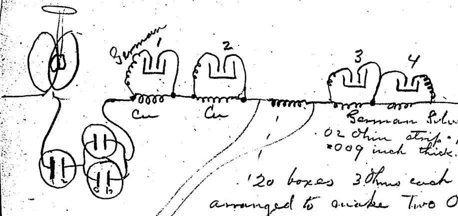
Remarks Nos 1 & 2 corroded a little

All in Cu. sulphate commercial with $\frac{1}{15}$ of sulphuric acid.

Plates placed in solution 9 a.m.

Taken out at 5 P.M.

Temp 70°7



German Silver shunt
.02 ohm strip .1 inch wide
.009 inch thick. 1' 5.5"

.120 boxes 3 ohms each
arranged to make Two Ohms

7 High resistance

TAE

May 18

4-1	Started
4-5	5°-20'
4-28	6°
	6°
	130 on 2 ohms
5-6	5-0 5-5 5-1
5-9	Stopped

27.715
27.514
.201
1.00
27.514
27.624 1.4412
.1361 $\bar{1}$.1338
(1) 203 2.3074

1.4412
.1237 $\bar{1}$.0920
(2) 223 2.3492
page 213 for shunt
(3) 1/223 1.4412

1.4412
(4) 1/204 .1349 $\bar{1}$.1300
2.3112

May 18 Results

Deposited in One cell | Two cells by Weber

Page 80 9.796 ~~T~~ 9.727
17.051 17.648

Page 94 27.541 27.715
54.388 55.090
54.388
.702 $\bar{1}$.8463 .702
54.3 1.7348
2.1115

. 1.3% difference

page 104 54.388 55.090
15.528 14.985
69.916 70.075
69.916
.159 $\bar{1}$.2014 .159
70.0 $\bar{2}$.8451
$\bar{3}$.3563

0.22% difference
all results

417.642
394.295 (1+2)
811.937

813.501
811.937
2/1.564
.782 loss

415.194
400.324 (2+3)
815.518

815.777
815.518
2/.259
.129 loss

406.180
415.917 (3+4)
822.097

822.097
821.971
/.126
.063 gain

410.615
394.295
16.310
.782
15.528

15.528
14.985
/.543
.271

423.583
415.194
8.389
.129
8.260

8.260
6.725
14.985
.271
15.256

412.842
406.180
6.662
.063
6.725

Page 103

May 19

Current from one bichromate cell passed through system

10 hours

	Grammes	Grains
1	417.642	10.9
2	394.295	4.4
3	415.194	3.
4	400.324	5.
5	406.180	2.7
6	415.917	14.2

15.256
Comp 600
19.5

4.1832
7.2218
8.7100
.1150

1.3 Webers

20.0923
19.8223
(1) .1897
.0103
.1794

Wrong

(2) 19.7105
19.649
.0615
.0088
.0527

14.1003
14.0565
.0438

(3) 16851
16.819
.032

17.016
16.9725
.0435
.0057
.0378

(4) 18.4308
18.4005
.0303

20.255
20.2107
.0443
.007
.0373

Lawson's plates

TOR

1
18.814
19.8223
38.6363

38.657
38.6363
2 | .0207
.0103

2
14.1003
19.649
33.7493

33.7670
33.7493
2 | .0177
.0088

3
16.851
16.9725
33.8235

33.835
33.8235
2 | .0115
.0057

4
20.2107
18.4308
38.6415

38.6555
38.6415
2 | .0140
.007

$\cdot 15256$ Bad connection in shunt 1.1832

$\cdot 1794$ $\bar{1}.2539$

(1) $\frac{1}{84}$ 1.9293

(2) $\frac{1}{280}$ $\cdot 0527$ 1.1832 $\bar{2}.7218$ 2.4614

(3) $\frac{1}{476}$ $\cdot 032$ 1.1832 $\bar{2}.5051$ 2.6781

(4) $\frac{1}{503}$ $\cdot 0303$ 1.1832 $\bar{2}.4814$ 2.7018

476

979

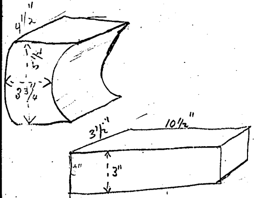
489 $\frac{1}{489}$ page 212

May 19

Small cast iron motor

Dimensions TAE

Magnet 3" diameter
18" long



4.85

70.6	0.8488
36	1.5563
.26	$\bar{1}$.4150
66.1 lbs	1.8201

10.5	1.0212
10.5	1.0212
.26	$\bar{1}$.4150
28.6	1.4574

28.6
66.1
94.7 lbs iron in magnets

4.96
2.5

19.32	
4.91	
14.41	1.1587
4.56	0.6590
.26	$\bar{1}$.4150
17.1	1.2327

$\frac{1698}{} \times \frac{\text{Volts}}{6.8}$ = efficiency current on magnet

3.22995
0.83325
2.3974

May 19. Cast iron motor.
Armature 0".014 plates
0".001 of tissue paper between them.
Wooden core 2".5 diameter
Iron outside 4".96 "
Length Thin plates 4".44
Total length iron 4".56
Magnet wound with 3 layers 0".049 wt. 10 lb.
Resistance 6.8 Ohms

One magnet arm 283 turns in each layer
X6 = 1698 turns Total both sides

Armature 37 coils each wound with two wires of three turns

Old machine

magnet	28	1.4472
	72	1.8573
	.28	$\bar{1}$.4472
564 lbs		2.7517

	42	1.6232
	21.5	1.3324
	.28	$\bar{1}$.4472
253 lbs		2.4028

253
564
717 lbs of iron magnet

May 19

TAE

1640 revo. 25 Volts on field magnet 6.8 Ohms
16.6 Volts from armature
.17 Ohm internal resistance

Old machine 1100 revo
120 Volts could be obtained
and used 9 inches face
75 coils X 2 turns = 150 turns

150	120	2.0792
9	1350	3.1303
1350		$\bar{2}$.9489

.0889 Volts per inch

log $\frac{1}{1350}$ = 6.8697
constant of old machine to reduce to volts per inch

25 1.3979

1.3979

1.6464

comp 6.8 9.1675

3.6097

4080

Old regular 10"

.75 $\bar{1}$.8751

3.14 0.4969

1100 3.0414

3.4134

2590 feet per minute at 1100 revs.

2500 3.3979

2590 3.4134

$\bar{1}$.9845

to reduce to surface speed of 2500 from 1100

$\bar{2}$.9489

$\bar{1}$.9845

.0858 $\bar{2}$.9334

May 19

Cast Iron machine

37 coils 3 turns = 111 turns

4.5 inches

16.6 1.2201

comp 111 7.9547

comp 4.5 9.3468

$\bar{2}$.5216

.0332 volts per inch 1640 revs

$\bar{2}$.5216

2200 3.3424

½ anger comp 1640 6.7852

.0446 8.6492

.0446

2

.0892

That is with the same surface speed the cast iron machine of ½ dimensions gives ½ the E.M.F. per inch of wire wound on it.

8.6492

Page 116: $\bar{1}$.9845

$\bar{2}$.6337

.043

2500 feet per minute .043 Volts per inch

37 commutators
3
111 turns
4.5
555
444
499.5 inches of wire
2 as rewound page 241
999.0 inches of wire

34
7.7

Regular 10"

2X75 = 150 turns
150
9
1350 inches of wire

20" 2X75 = 75 turns
75
9
675 inches of wire

If magnet cast iron machine were wound with No. 10 wires three layers it would have one fourth the resistance of the regular machine :

4) 1.51
.37

Multiple arc the sides and each layer will give $\frac{1}{36}$ of this or about .01 Ohm

If armature be wound with one turn it will give $\frac{1}{9}$ of present resistance or about .02 Ohm the machine would have 5 Volts E.M.F and a resistance of .03 Ohm which would make an

Magnets Cast iron 4.5"

1113 .1698 3.2299

comp 6.8 .8325

2.3964

Constant to X Volts by

261

2 | 1752

876 2.9425

excellent plating machine

May 19

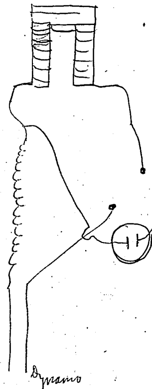
Make meters two of each kind

Coil with meter	Shunt
5 Ohm	.005

Strip German silver
2' 6" by 6"

5 Ohms		.001
strip 2' 6" by 3"		
5 Ohm strip 3'	by 2"	
5 Ohms strip 3'	by 1"	.04
10 Ohms " 3'	by 1/2"	.08
10 Ohms 6"	by 1/4"	.32
20 Ohms 12'	by 1/4"	.64

To determine the amount of discharge from a magnet



page 133

404.318
406.259
810.577

417.642
404.318
13.324
.1.360
17.964

811.937
810.577
1.360
.680

406.259
394.295
11.964
.680
12.644

Large plates current of two cells for 6 hours yesterday May 19

No.1 404.318 4.9
2 406.259 4.

See page 105 TAE

38.6363
38.6254
2 | .0109
.0054

19.0292
18.814
.2152

33.7493
33.7355
.0138
.0069

19.649
19.597
.052
.0069
.0589

33.8235
33.8125
.0110
.0055

16.9305
16.851
.0795
.0055
.0740

38.6415
38.4782
2 | .1633
.0816

20.2107
20.0167
.1940
.0816
.1124
.0740
(0).1864
.0932

May 20. Meter.

Lawson's plates Page 107

1. 19.0292
19.5962
38.6254

New handle
19.0278

2 19.597
14.1385
33.7355

3 16.9305
16.882
33.8125

16.882
16.851
.031

16.9725
16.9305
.0420

4 20.0167
18.4615
38.4782

May 20 Meter

12.644	4.1018
215.2	2.3328
	1.7690
58.7	
	4.1018
589	
	4.1018
	4.1018

12644	4.1018
.0932	1.9694
	2.1324

1
135

May 20 Discharge of magnets page 125

Resistance magnet 1.4 Ohms

6 | 330.00

5500 3.7404

44.3 8.3536

1.4 .1461

2 | 2.2401

1.1200 13 Volts

$ft\,lbs = \frac{V^2}{R} \times 44.3$

$V^2 = \frac{R\ ft.lbs.}{44.3}$

8.5 1.9294

1.3 1.1200

.8094

.1461

9 Ohms .9555

Large Magnet 1.94 Ohms

$\sqrt{2} = 1.41$ $\dfrac{2)\,.3010}{.1505}$

Magnet 4 per H.P.

$4\,)\,\overline{33000}$

8250 3.9165

1.94 0.2876

Comp .4.4.3 8.3536

$2\,)\,\overline{2.5577}$

1.2788

19

19 Volts on magnet.

page 197

May 20

Plate No 5	405	14.5
	6	415	7.7

Wrong connection made so that main current run through plates

Plate No. 5	405	10.4
	6	415	10.5

Started 10-36
break every minute
Cross found in wires to galva.

Plat 5	405.	10.4
	415.	9.5
50 Times	405	6.7
	415	10.9

Nly.

23 page 112	1.3617	21.5	1.3324
	2.3974		2.3974
5740	3.7591	5350	3.7298
21	1.3222	19.5	1.2900
	2.3974		2.3974
5240	3.7196	4860	3.6874
17.1	1.2330	14.7	1.1673
	2.3974		2.3974
4270	3.6304	3670	3.5647

Resistance 6.8 Ohms
cast iron machine
10 = 1 Volt speed 1600

E. M. Fon Magnet	Armature	
23.0 Volts	15.8	
21.5	15.5	31
	14.4	28.8

Belt tightened
1640 - 1660 revo

	21. Volts	15 Volts	
	19.5	14.5	
1620 revo	17.1	14.5 Volts	29
		14.3	

Current broken on magnets same resistance as before

10-40		C.B. 13.8 Volts	
	17.1	13.3	26.6
	14.7	C.B 13.	26

On magnet		Armature	
12.3	CB	12.3 12.3	24.6
11.9		11.9	23.8
11.3	C.B	11.9 11.8	23.7
		11.0	22
8.5	C.B	10.7 10.4	21.4 20.8
		9.5	19
5.35	C.B	8.7	17.4

50. Permanent
Brought up

21.5	15 Volts	30
25 Volts	15.6	31.2
29.2 Volts	16.9	33.8
29.2	17 Volts	34
25 Volts	16.5 volts	33

1254
2
2408
4
9632
1.5
48160
9632
1.444.800 ft. lbs

918
16
5508
918
14.688

1
918
2
1836

Cast iron motor
1254 revs 1/2 minute
1 lb. 8 oz. at 4 ft

918
2 lbs at 4 ft
at 46 Volts
2408 revs per minute
14,448 ft lbs

1836 revs
14.6856 ft lbs
probably too high as I had
to take two lbs. as a round
The motor put with 80 Volts
the centrifugal force burst the
brass wire

404.328
357.518
46.870 loss
.76
46.11

450.454
405.382
45.072 gain
.76
45.81

May 21

		Meters Grammes	grains
Plate	1	404.328	4.9
	2	406.238	3.7
	5	405.382	5.9
	6	415.8100	12 5
		1631.758	
After		Grammes	grains
	1	357.518	8.
	2	451.486	7.5
	5	450.454	7.
	6	369.259	4
		1628.717	

1631.758
1628.717
4) 3.041
.76

19.1592
19.0278
.1314 gain
.0411
.1728

19.597
19.394
.203 loss
.0357
.1673

17.0335
16.9305
.1030 gain
.0465
.1495

20.0167
19.843
.1737 loss
.0336
.1401

May 21
Niter

192
384

Lawson's plates in two sets

after	before	
19.1592	19.0278	(1)
19.3825	19.5962	
38.5417	38.6240	
	38.5417	
	.0823	
	.0411	
19.394	19.597	(2)
14.270	14.1385	
33.664	33.7355	
	33.664	
	2 | .0715	
	.0357	
17.0335	16.9305	(3)
16.686	16.882	
33.7195	33.8125	
	33.7195	
	.0930	
	.0465	
19.843	20.0167	(4)
18.568	18.4615	
38.411	38.4782	
	38.411	
	.0672	
	.0336	

In the solution about 24 hours.

3 lbs coal 0.4771
2240 in ton 6.6498
$ 4.50 2.6532

.7801

.6 cts per hour for coal
8 lights
.075 cts per lamp per hour

5 cu.ft
1/200 of 1000 ft at
.5 ct per hour
$1.00 per 1000 cu.ft.

95 : 119 :: 85.5

1.9320
2.0755
8.0223
2.0298

107 Ohms

80

1.9031
1.9031
1.6464
7.9702
3.4228

265 D

Lamps Bast fibre
8 May 22

Resistance of line 85.1 Ohms

Lamp 1085

R cold .153 Ohms

9-55

240 on H.R
95 on L.R
7.5 candles
119 on resistance 85.1
240 on H.R

115 ; 133 ;; 85.1

	85.1	1.9299
	133	2.1239
amps	115	7.9393
		1.9931

98.4 Ohms

3)260

	86.6	1.9375
	86.6	1.9375
	44.3	1.6464
amps	98.4	8.0069
		3.5283
3370		4.5185
		99.02

9.8 per H.P.

No. 1085 May 22

15 candles

10-15

260 H. R

115 L. R

133 on 85.1 Ohms

258 H. R

1085	1083	candles
2650	2620	7½
3370	3380	15
4160	4225	30

2650
883
3433

(2620
873
3493

(2650
66.2
3312

4(3370
8.42
4212

133.5 ; 145 ; 86.5

1.9370
2.1614
7.8745

94 ohms 1.9729

3)282
94

1.9731
1.9731
1.6464
8.0271

4160 3.6197

30 candles

10-30 282 H.R
133.5 L.R
145 on ~~85.1~~ 86.5 Ohms

30 candles
10-40 281 H.R
133 L.R
145 on ~~85.1~~ 86.5 Ohms

104 : 120 :: 86.

1,9345
2.0792
7.9830

1.9967

99.2

3 (230
76.6

1.8842
1.8842
1.6464
8.0033

3.4181

2620.

R = 145 Perfect carbon

7.5 candles

10-48
230 H.R
103 L.R

7.5 candles

231
105 L.R
120 on ~~85~~ Ohms
86. Ohms

117 : 132.5 :: 88.

88	1.9445
132.5	2.1222
117	7.9318
	1.9985

99.6 Ohms

3) 251.5
87.2

	1.9405
	1.9405
	1.6464
	8.0015
3380	3.5289
	4.5185
9.76 per H.R	.9896

No. 1083 May 22

15 candles

251.5 H.R

117 L.R.

132.33 on 85.1 Ohms

15 candles again

11-10 253 ~~H~~.R

119 L.R

133 on 85.1

158

136.5 : 142 :: 86.5

1,9370
2,1523
7,8649
1.9542

90 Ohms

3

275
91.6

1,9619
1,9619
1,6464
8,0458
3.6160

4130

4)3380
845
4225

4130
3380
750)33000(44
3000
300

Lamps No. 1083 1053 May 22 159
30 candles

275 H.R
137-36 L.R
11-25 142 in ~~85.1~~ Ohms
86.5

2620
3380
4225

1/3)2620
873
3493

7 1/2 Average
15

2620
2650
5270
2635

30
4160
4225
8385
4192
3375
817

3375
2635
740

2635
740

3.4288
2.8692
.5516

3375
817

3.5282
2.9122
.6160

3.56

4.15

page 200 paper lamps

Lamp no. 1094 May 22

R 123 Ohms cold
perfect carbon.

15 candles ?

.240 H.R

11-30 127 on 8511 Ohms

No 1093 May 22

R 145

perfect carbon

18 candles

223 H. R

123 L. R.

15 candles Edge 14 candles

230 H. R

123 L. R

11-55

Resistance 92 Ohms ?

1118
255.454

862.546
.0022

1725092
172509

1.897599

1.9 lbs of H_2O

25.54
.0022

5108
5108

.056188
1.9

1.96 lbs H_2O

May 22

Calorimeter test New Model paper

Total wt of Calor
grammes
203 5.8 grains

wt of vessel 168 7 grains

with glass Grammes 255.454 grains 7

1118

87 Ohms resistance boxes

71 : 102 :: 87 :

87	1.9395
102	2.0086
comp 71	8.1487
125 Ohms	2.0968

3 | 195
65

65	1.8129
6.5	1.8129
	1.6464
By galva.	7.9032
1500 ft.lbs.	3.1754

26.3	1.4200
775	2.8893
1.96	0.2923
Comp 32	8.4949
	3.0965

1250 ft. lbs.

93
66.7
26.3

3.1754
3.0965
.0789

120

2-34 Temp air 80° F New moulded paper

195 H.R
102 L.R on 87 Ohms

66.7° F

2-40 Started

80.
66.7
13 3
93.3

71 L.R
2-44 71 LR
46 195 H R
3-6 Stopped
2-34
32

93° F 102 on 87

106 : 137 :: 87 :

87	1.9395
137	2.1367
comp 106	7.9747
112. Ohms	2.0509

(265
683

68.3	1.8346
68.3	1.8346
	1.6464
	7.9491
1840 ft lb	3.2647

May 22 – 1880

New mould paper

1.127 grammes 7 grains

3-22	137 on 87 Ohms
3-25	Started 65°.9
	264
	82
	65.9
	161
	62.
	98.1
	252
	279
	(531
3-28	265 H.R
	106 L.R
3-41	97°.57 Stopped
22	137 L.R
19	

1127.7
255 8
.972
.0022
1.844
1844
2.028 4
.056
2.084

97.5
65.9
31.6

2.08 0.3181
775 2.8893
31.6 1.4997
compl 9 8.7212
1700 3.2283

3.2647
3.2283
1.0364

109

87 Ohms

(326
108.6

2.0350
2.0356
1.6464
8.0605
3.7779.

6000

1124
255.5
868.5
.0022
17370
1737
19107 0
.056
1.967

1.967 0.2938
30 1.4771
775 2.8893
comp 11 8.9586
4150 ft lbs. 3.6188

3.7779
3.6188
.1591

144

Calorimeter May 2

1124. Grammes New mould paper

157 on 87 Ohms

3-51 310 H.R
342
~~1652~~
326
~~678~~

air 82

3-54 68° F Started

155 on L.R

82
68
14
82
96

4.2 98° F

4.58
429
29

1444
1330
2|114
57

29 : 60 :: 57 :
60
3420

Candle burnt
118 grains a minute

3.5340
1.4624
2.0716

24
9
4|31
8
23

128 : 136 :: 87
92.4 Ohms

1.9395
2.1335
7.8928
1.9658

3|276
92

1.9638
1.9638
1.6464
8.0342
3.6082
4.5185
.9163

4050 ft lbs

9.13 per H.P.

May 22

Paper large mould
1444 candles weighed
4-29 P.M Started

276 H.R

24 candles side
136 L.R on 87 Ohms

9 candles edge.

128 - 27 L R
280 H.R

136 L.R on 87 Ohms

4-58 P.M. candles
weighed 1330 grains

176 263

247.8	82.6	87.9 Volts	10 Candles
266	88.7 Volts		
250.2	83.4	11	12
268	89.6		
253.2	84.3	11.25 12.5	13
272	90.8		
256.2	85.4	13.25	
275	91.9		
258.9	86.3	14	
279.	93		
262.2	87.4	14 16.25	16.5
282	94.1		
265.5	88.5	16.5	16.25
286	95.4		
269.2	89.9	19	19.25
290	96.8		
273.	91.	20	
295	98.3		
277.5	92.5	20	24
300	100		
282.	94.	29.	

May 22 87.9 89 1.9440
$\bar{1}.9731$
82.6 1.9171

1.9481
$\bar{1}.9731$
1.9212 ✓

1.9526
$\bar{1}.9731$
1.9257 ✓

1.9582
$\bar{1}.9731$
1.9313 ✓

1.9631
$\bar{1}.9731$
1.9362 ✓

1.9683
$\bar{1}.9731$
1.9414 ✓

10

1.9739
$\bar{1}.9731$
1.9470 ✓

13 - 19.

1.9797
$\bar{1}.9731$
1.9538 ✓

1.9860
$\bar{1}.9731$
1.9591 ✓

1.9929
$\bar{1}.9731$
1.9660 ✓

May 24 Motor

Cast iron machine
armature rewound six turns
0.61 Ohm

25 Volts on magnet

32.6 from armature

driven 1640 revs. per minute

32. Volts on magnet and
armature as motor
1480 revs

Fresh battery about 10% higher than
cells in use

148 : 143 :: 87

1.9395
2.1553
7.8297

84 ohms
1.9245

309
103

2.0128
2.0128
1.6464
8.0755

1181
255.454
5600
3.7477

H_2O 925.546
vessel 20
945.5

945.5
.0022
775
338

2.9754
$\bar{3}$.3424
2.8893
1.5289

comp 9
9.0458

3.7818

6050

Galva. 5600
Calor 6050

new mould carbon
81 Ohms in resistance

1-35 1181 Grammes

289
330
619.
309.5 H.R

743 on resistance 87 Ohms

1-43 67.2 Started

84
67.2
16.8
84
1008 102°

287
336

147.5 L.R
148

1-52
43
9

101.7 Stopped
67.2
33.8

1175
2555
9195
20
939.5 2.9729
.0022 $\bar{3}$.3464
775 2.8893
39.5 1.5966 Calor.
cump 13 8.8861
4911 ft 3.6913

150 : 145 :: 87. 1.9395
2.1614
7.8239
1.9238
83.9 Galon.
102 2.0086
2.0086
1.6464
8.0762
5490 ft. lbs 3.7398

May 24

New mould carbon
1175 grammes
1-30 .145 on 87 Ohms

2.35 63.9 F Started

.84
63.9
20 1
84
104. 147.5 L. R
~~75~~

325
285
610
305. H. R
2-44 150 L. R

2-44 103.4 F
63.9
39 5

184

May 24 185

3/10 P.M. Lamp No. 1085 Bas[illegible]

240-2	8 candles		
230-2	6.5		
220-2	4 4		
210-2	3.25		
200-2	2.25		
240-2	7.25		
	8	8	7.75
	9		
	9, 8, 8, 8.75		
250-2	11		
260-2	15.5	16.75	16;
270-2	21.5	20	
280-2	27	27.5	

Lamp No. May 24 1085 Bank

on lamps

H.R.	L.R
276	127
272	123
262	118
250	110
~~240~~ 228	102
220	~~8~~ 90
218	89

On 87 Ohms

210	98
219	101
230	109
258	120
280	131

4-30 P. M.

May 24
1094
28 candles
267 H, R
150 L, R

270 30 candles

1094 May 2 84

15 candles

235 H. R

128 L. R

111 on 87 Ohms

111 on

1156
255
895
20
915

96
72.25
23.75

775	1.	3756
915	2.	8893
	2	9614
.0022	3.	3424
comp 8	9.	0969
4630	3	.6656

150 : 143 : : 187

1.9397
2.1553
7.8239
1.9189

83 ohms

1306
102

2.0086
2.0086
1.6464
8.0811
3.7447

5555 ft lbs

(71.25
72.25) ?

85
71.2

85
72.25
12.75
85
9.725

5-16	
18	78
19	81
20	84.5
21-30	88.25

288
325
613
306
150

H. R
L. R

5.24
5.16
8

96° f
143 on 87 Ohms

1120
255
865
20
885

.885
.0022
775
28.9
Comp 9.

2.9469
3.3424
2.8893
1.4609
9.0458
3.6843

4800

4800 ft. lbs calor
5500 " " galva

7404
6843
.0561

1.13%

May 23

1120 grammes total weight

5-34 69°.5 F Started

85
69.5
155
85.
100 5

149 L. R

305 H. R

5-43 98°.4 F
69.5
28 9

$$n = \frac{375.36}{\sqrt{l}}$$

$$\sqrt{l} = \frac{375}{n}$$

$$\cdot\ l = \left(\frac{375}{N}\right)^2 \qquad n = 34.2$$

2.5740
1.15338
1.0402
2
2.0804

121 inche
30 1/4 inches

2 ft 6 1/4

Test of large machine May 25 1880

see page 135 for magnet

$\frac{106}{5} = 21.2$ Volts on magnet

$\frac{45}{5} = 9$ Volts from armature turning 100 revolutions per minute Page 205

4' 10 1/2" Large pulley
58.5 inches
20 inch dynamo pulley

$\frac{20}{58.5} \times 100$

3.3010
1.7672
1.5338

34.2 per minute

May 25

2634
453

.4200
.6561
1.0761

11.9

2.22
10.8
24

.3464
1.0334
1.3798

 Small loop carbon round

From diagram

5 candles 2275 ft. lbs

10 candles 2750

2275 3.3560

475 2.6767

·6793

4.67

10 candles 2750

20 candles 3650

2750

900

3.05

Large carbon 2725

5 candles 3400

2725 3,4354

675 2.8293

·6061

400

3400

4300

3400 3.5315

900 2.9542

·5573

360

Bast fibre p. 159

Wood lamps

Tested by Jehl

R 83 Ohms cold

50.2 Ohms hot 15 candles

48.6 " 30 "

4670 ft. lbs 15 candles

5932 " " 30 "

4670 3.6693

1262 3.1004

·5689

3.7

20" machine

2 ohms in magnet
Very warm day

11.000 ft. lbs. p. 135

$$Ft.lbs = \frac{V^2\,44.3}{R}$$

$$V^2 = \frac{R\ ft.lbs}{44.3}$$

$$V = \sqrt{\frac{R\ ft.lbs.}{44.3}}$$

11000 22000 4.3424
R=2 0.
8.3536
2 | 2.6960
40 1.3480

22.2 Volts
5
111

222 10. to a Volts

22.2
.7
1554
222
37.74

Armature 10 inches over all
9" of iron
8" of plates
1" end plates

When reduced in diameter
8" of plates only cut.

Page 197 also Large 20" machine

21.7 Volts on magnet

17.5 – 18 Volts from armature at 200

44 Volts on magnet
9 at 100

Magnet	Armature at 100 revs
18.5 Volts	8. / 8.5
12.5	8.2
8.8	7.5
dropped to	2.5 immediately and to 1.5 in about 1/2 minute
	7.0
6.9	7.0 down
	6.0 up
5.5	6.4
	6.

.00336
9
.03024
2
.06048
649
.06697

32.5

9.2 Volts

9.1

75 Turns give 9 Volts
1.0 inches long ?

12|19 inches
1.58
3.14

9.1987
9.4969
0.6956

2500 3.3979
2.7023

504 r.p.m. to give surface speed of iron of 2500 feet per minute

.000666
504.
.00336 $\bar{3}$.5263

Constant to obtain inch of wire page 116

14.5433 · 15.5703
14.513 · 15.4925
3 0 3 · .0778
.054 · .054
.0303 · .0238
.0237

15.673 · 20.476
15.6023 · 20.446
.0707 · .030
503
.0204

18.078
17.9435
.1345
.0711
.0634

16.2165 · 1852
16.1168 · 173
.0997 · .0122
.0559 · .0559
.0438 · .0437

.0634
.0438
.1072
.0536 Averag 374

May 26

Meter Lawson's plates

(1) 14.5433 · 14.513
15.5703 · 15.4925
30.1136 · 30.0055
30.0055
2 ⟌.1081
.0541

(2) 15.673 · 15.6023
20.476 · 20.446
36.149 · 36.0483
36.0483
.1007
.0503

(3) 18.078 · 17.9435
15.385 · 15.3772
33.463 · 33.3207
33.3207
.1423
.0711

(4) 16.2165 · 16.1168
15.1852 · 15.173
31.4017 · 31.2898
31.2898
2 ⟌.1119
.0559

14.406
14.4155
14.406
(5) .0095

15.695
15.5793
.1157
.0626
.0531

24.990 4.3979
53.1 1.7251
1/470 2.6728

16.3147
2957
.0190
(6) .0591
.0401

40.1 4.3979
1.6031
1/623 2.7948

357
331.81
25.19
.665
24.525

24.990 4.3979
comp 24 8.6198
comp 19.5 8.7100
comp 66 8.2218
.89 Weber 7.7495

414.97
389.32
.25.65
.18
25.47.

24.52
25.47
49.99
24.99

Lawson's plates

(5)
14.4155 14.406
15.695 15.5793
30.1105 29.9853
29.9853
1.1252
.0626

(6)
16.3147 16.2957
18.8615 18.7623
35.1762 35.0580
.0580
2 | .1182
.0591

Large plates

1 357 331.81 12.5
2 450.97 15 477.49 7.5
3 414.97 15 389.32 5
4 400.16 2.5 425.45 7

357
450.97
807.97

331.81
477.49
809.30
807.97
1.33
.665

414.97
400.16
815.13
814.77
.36
.18

389.32
425.45
814.77
407.4

39.4 Shunt

39.5 — 1.5966

.114 — $\bar{1}$.0569

2.5397 — $\frac{1}{346}$

(576)

576 — 1.7604 — $\frac{1}{503}$

.114 — $\bar{1}$.0569

.7035

314 $\frac{1}{200}$ Shunt if cell no resistance

24.99 — 1.3977 — (1) $\frac{1}{1050}$

.0237 — $\bar{2}$.3747

3.0230

.02) 11.50

575

24.990 — 1.3977

.0536 — $\bar{2}$.7292

$\bar{2}$.6685

Ratio $\frac{1}{466}$ (314)

466

489

955

477

page 108 $\frac{1}{489}$

average 1 ~~Lamp~~ $\frac{1}{477}$

Each meter

Meter No 1 ~~and~~

		main line	branch
No 1 Shunts		.0208	11.5
No 2	"	.021	12. Ohms
(9) 3	"	.021	4.2
(10) 4	"	.0209	4.1
(11) 5	"	.114	39.400
(12) 6	"	.114	57.5

.114 — $\bar{1}$.0569

0208 — $\bar{2}$.3181

0.7388

12 — 1.0792

65.8 — 1.8180

Started 9-30 am

1 cell bichromate 24 hours

Stopped 9-30 a.m

2 candles

200 H.R

80 on lamp

93 on 87 Ohms

80 : 93 :: 87 :

1.9395
1.9685
8.0969
2.0049

101 ohms

3 (200
66.6

1.8235
1.8235
1.6464
7.9951
3.2885

1940

217.5 H.R

89 on lamp

101.5 on resistan

2.0054
1.9395
8.0506
1.9955

99 ohms

(217.5
72.5

1.8603
1.8603
1.6464
8.0045
3.3715
3.2885
2.6128
.6657

2350
1940
410

4.63

8 candles

239 H.R

102.7

112

2.0492
1.9395
7.9901
1.9788

95.2

239
79.6

1.9009
1.9009
1.6464
8.0212
3.4694

2940
2350
590

33715
2.7709
.6006

3.99

15 candles

259

116

121.5

1.0845
1.9395
8.9355
1.9595

91.1

259
86.3

1.9360
1.9360
1.6464
8.0405
3.5589

3620

218

20 candles

282

.87 Ohms

(282
94

1,9731
1,9731
1.6464
8.0605
3.6531
3.3589
.9912
.5677

4500
3620
980

3.7

16 candles

261

117

Fibre Lamp Bad spot in lamp

L R gild on lamp.	H. R
7	30
11	47
12	51
16	62
19	71
28	97
32	113
100	275
139	335
94	250
85	228
76	198

$\frac{\Omega}{3} = \sqrt{}$

On resistance 88 Ohms

H. R	L. R Jehl
200	90
270	120
298	135

H. R	Candle Francis
280	6. candle

Bad spot in lamp

H.R. 9 

Machines Exs

Fibre lamp

H.R	L.R.	Candles
270	R 123	
301	137	
179	L. 62	27" inches
190	65	30".5 inches
198	69	30".6
210	75	39".25
230	84	3.25 candles
253	95	7 candles
282	110	17.25 candles
310	135	65".5 <u>inches</u>
285	120	34 Candles
290	123	26.5 C
272	115	18.75 C
275	114	20 C
282	117	22 C
286	122	25

Motor (May 27

445 revs ½ minute

5 lbs at 12 feet

$\frac{200}{1.5}$ Volts

~~[illegible]~~

242	95
112	35
128	41
132	45
165	59
185	68
~~250~~	+
265	110

Large machine

Magnet		Armature
25.	5 Volts	8.
		4 × 2
19.0		8.

15
15
75
15
125
44.3
375
500
500
5537.5
2) 5537.5 ft lbs
2768.

Two layers of wire

2768) 33000 (12 for H.P.
2768
5320

page 272 strong current

387
338
723
362

$\frac{1}{362}$

Results meters

Cells 3 & 4 were used twice with same shunt and resistance and about the same current in main line and the average

page 108 $\frac{1}{489}$
212 $\frac{1}{466}$

average $\frac{1}{477}$ page 272

To calculate the current and the E.M.F.
Current found by Cu. or by H.R.G
Resistance cell measured,
Current multiplied by resistance give E.M.F. = Volts used up in R, the dif but this and Volts on line give E.M.F of cell

May 31 1880

Large machine page 203 100 r.p.m.

Volts on magnet Armature

10.8 7. Moderate day

4-40 12.5 7.5

Broke current

12.5 7.5

4-45 15.9 8

4-47 Broke the current

Two minute 7.3

4-49 15.9 7.7

Ball swinging wider

15.9 7.5

4-52

brought up to

8.

21 8.

Broke

5.56 7.7

one minute 8.1

short circuited 8.3

21

Volts on magnet

		from
5-3	30	8.2
5-8		
	10.5	7.3
		7.
		7.
	9.5 broke current	7.
		6.6
	5.7	5.7
	4.9	~~4.5~~
		5.4
		5.3
	broke 10"	4.5
	after 11	4.7
		4.6
	all off	2.8

292 Turns one layer magnet

$$\begin{array}{r} 292 \\ \underline{6} \\ 1752 \end{array}$$

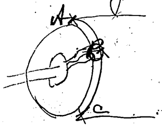
35 | 1 - 3

90 - 100

70 - 85

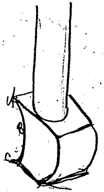
80 - 90

The wires connected on the large machine so that the current ~~[illegible]~~ generated in each could be separately tested:



A strength 90-100 = Deflection.
B 70 - 85 = Deflection
C = 80 - 90 = D

This shows that the distribution of magnetic effect is very nearly the same throughout the whole field.



In ~~Small cast iron machine~~

2 feet of German silver wire 0."0265 in diam has a resistance of 0.17 Ohm

$\frac{0.17}{0.085}$ one foot

0."0265

26.5

551.5 <2.7412

.085 $\bar{2}$.9294

1.6~~7~~.06

46.7 Ohms

mill foot 46.7 in place of 127.3 as give by Jenkin

157 2.1959

.085 $\bar{2}$.9294

13.3 1.1253

Cast iron motor which never had any current on the magnets.

Machine run 1640 rev.

Magnets	Armature
0 Volts	0 Volts
~~5~~	~~2~~
$\frac{7.5}{20} = 0.375$	$\frac{9.5}{20} = 0.475$
Current broken	$\frac{1}{20} = .005$
$\frac{12.5}{20} = .625$	$\frac{18}{20} = .9$ Volts
Current broken	$\frac{4.5}{20} = .022$
$\frac{25}{20} = 1.25$	$\frac{46}{20} = 2.3$
Current broken	$\frac{15}{20} = .75$
$\frac{45}{20} = 2.25$	$\frac{115}{20} = 5.75$
Current broken	$\frac{50}{20} = 2.5$

On magnet Armature

$\frac{29}{5} = 5.8$ $\frac{76}{5} = 15.2$

Current broken $\frac{39}{5} = 7.8$

$\frac{43}{5} = 8.6$ $\frac{102}{5} = 20.4$

Current broken $\frac{48}{5} = 9.6$

$\frac{93}{5} = 18.6$ $\frac{157}{5} = 31.4$

Current broken $\frac{61}{5} = 10.2$

$\frac{250}{5} = 50$ $\frac{217}{5} = 43.4$

Current broken $\frac{77}{5} = 15.4$

$\frac{300}{5} = 60$ $\frac{240}{5} = 48$

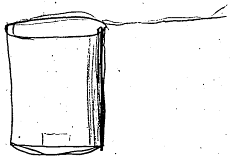
Current broken $\frac{83}{5} = 16$

6.7 Ohms in magnet

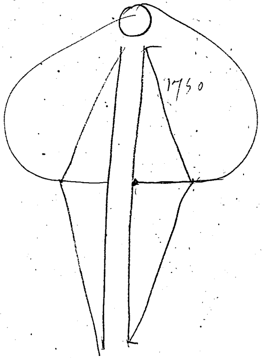
after 2½ hours permanent $\frac{39}{3} = 13$ Volts

$\frac{220}{3} = 73.3$ $\frac{145}{3} = 48.3$

Current broken $\frac{38}{3}$ Volts

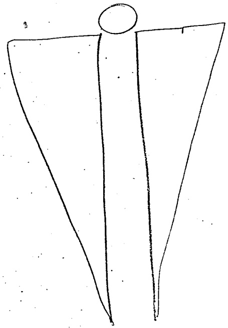


TAE
June 1 1880

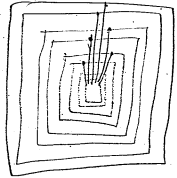


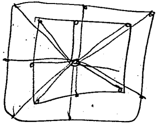
14.19

TAE
June 1, 1880.

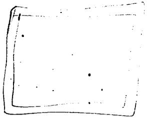


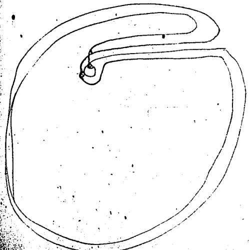
F.R.U.
June 1, 1880



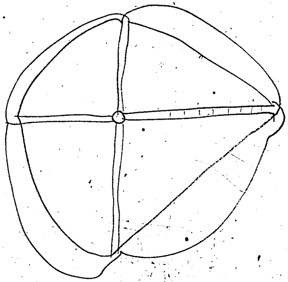


F.R.U.
June 1, 1880.

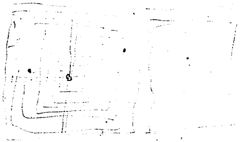


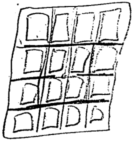


JRU
June 1 1880

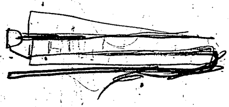


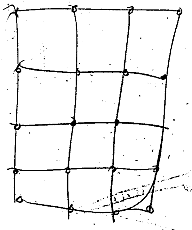
JRU
June 1, 1880.



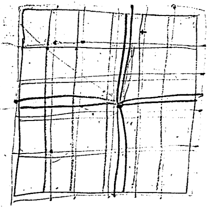


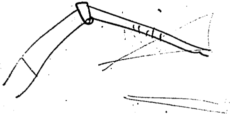
JRU June 1, 1880

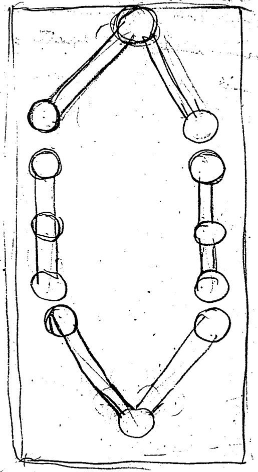




JRU June 1, 1880







Distribution June 4

Exs. tobe made and calm

Make artificial systems.

Required resistances of a system

100 Ohm boxes

Machines

Laws of winding in general terms

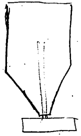
Law of magnets
Cast and wrought iron.
Whether the armature is magnetic at high speeds
Summaries of tests already made

Motors

Laws

Test with varying E. M. F and with varying resistance.

Power absorbing dynamometer water friction



Meters

Shunts with various current to determine how the law of the shunt varies. The surface of the copper plates should be varied. The contrary E.M.F. is probably a function of the intensity of the current per unit surface

Comparisons pot. galva. and Cu. cell.

Lamps

Full test of at least five lamps of a kind

Resistance candle power foot lbs. with surface and kind of lamps.

Bridge, substitution, of Cu. deposition & calor.

Galvanometer

The cells should be thoroughly cleaned every week, plates amalgamated &c. A cu. test should be regularly made each day to see if all is in order and to make allowances.

It has been proved that a given current ~~of a certain fixed strength~~ deposits a fixed amount of Cu under all the ~~varying~~ conditions of practice.

Two deposition cells should be used to check observations and all the current passed through them

Resistance boxes in line

How do you [illegible]

Lawson's Plates

Plate 7 whole current

50.460
71.5265

(8) 56.430 + 55.205 = 111.635; 56.375 + 55.175 = 111.550; .635 − .550 = .85 [sic]

(9) 57.760 + 50.785 = 108.545; 57.645 + 50.795 = 108.440; .545 − .440 = .105; 52

(10) 55.670 + 55.815 = 111.485; 55.665 + 55.715 = 111.380; .485 − .380 = .105; 52

(11) 57.505 + 55.435 = 112.940; 57.430 + 55.455 = 112.885; 940 − 885 = 55; 27

12. 56.915 + 56.515 = 113430; 56.840 + 56.530 = 113.370; 430 − 370 = 60; 30

71.5265 − 50.460. = 21.0665
21

(8) 56.430 − 56.375 = .055

(9) 57.760 − 57.645 = .115; 52; .063

(10) 55.670 − 55.665 = 5; .52; .57

57.505 − 430 = .075; 27; .048

56.915 − .840 = 075; 030; 045

Large Plates

1 356.1944 3

477.49
2 450.648 10
26.842
1.229
25.613

3 413.713 11

425.45
4 400.259 4
25.191
.399
24.792
25.613
50.405
25.202

356.194
450.648
806.842
809.30
2.458
1.229

400.259
413.713
813.972
814.77
.798
.399

Meter

1	368	14.5
2	433	3.5
3	425	5.
4	386	5.

Meters

(8) 56.335

55.175 .020
111.510
111.550
.040

(9) 57.740
57.645
95
25
.070

50.650
108.390
108.440 .050

(10) 55.595 .080
55.665
.060

55.755
111 340
111 380
40

(11) 55.385
55.455
70
15
.085

57.470
112.855
112.885
30

12 56.760
56.840
.080
.015
.065

56.580
113.340
113.370
.030

56.840 56760
56.580 530
.260 230

Shunts page 213

No. 8	.020 mg
No. 9	.070
10	.080
11	.085
12	.065

No (1) 368.98
356.194
12780
1.516
14.302

1.5 2

(2) 434.23
368.98
803.21
806.842
3.632
1.516

3.7

(3) 425.356
413.713
11.643
11.146
12.789

5.5

2

(4) 386.324
425.356
811.686
813.972
2.292
1.146

5

14.302
12.789
27.091

Systems 3000

June 1

2270
1.135
780
1915
780

388218

10 8

8

78

825
825

825

2

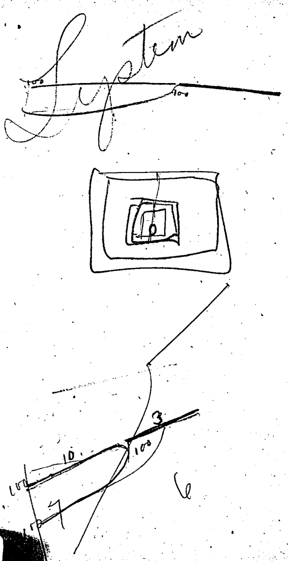
780 : 2270 :: x : 825
780
3050

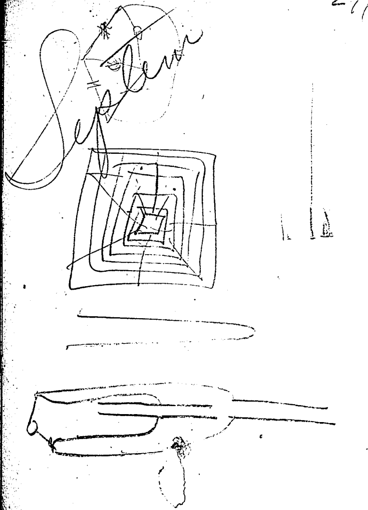
825

3050 : 1915 :: 825 : an
825
9575
3830
15320
3050) 1579875
15250
4487

510

440


System
100
100
0
10
100
3
100
100
6


System

(8) 20) 27.09x Meter
1354

$\frac{1}{1354}$

(9) 70) 27.09x
387

$\frac{1}{387}$

page 233

(10) 80) 27.09x
338

$\frac{1}{338}$

(11) 85) 27091 (318
255
159
85
744

$\frac{1}{318}$

(12) 65) 27091 (415
260
109
65
340

$\frac{1}{415}$

Shunt No. 5.

Ratio from resistance page 212

$\frac{1}{346}$

from Cu

small current — heavy

$\frac{1}{470}$ — $\frac{1}{318}$

Shunt No. 6

$\frac{1}{503}$ from resistance

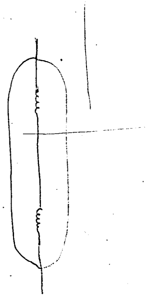
small current — heavy

$\frac{1}{623}$ — $\frac{1}{415}$.

60 tons
2240
60
134400 lbs
46
806400
5376
6)
33) 192 6 800
00

2) 5520
60) 2760
46

806400
5376
6) 61524 00
33) 110304 00



\$5000 59294..
67500 4.8293
1.1001

\$1.25.

125000 5.0969
67500 4.8293
.2676

\$1.85 at consumers

~~85~~

July 23 1880 F R Upton.

Boilers & Chimney	21.000
Engines	21.000
Foundation	2.000
Iron Structure	3.500
Wood flooring	1.000
Water heaters & pumps	7.000
Iron floor and supports	6000
Faradic Machines	24.000
	85 000
Conductors	50000.
	125000

6 per H.P.

1250.
6
7500
9 ~~1000~~
67500

\$1.85. investment
per M annually

9 | .0004433
.00004925
5
.00024625
8
.001688

.003824
8
.030592

180
100
9
5

Depreciation & repairs

Boilers & Chimney	10%	$ 2100
Engines	3%	630
Foundation	1%	20
Iron Structure	2%	70
		50
Wood flooring	5%	
Water heater & pumps	5%	350
Iron floor	2%	120
Faradic Machines	3%	720
		4060
~~Condu~~ Conductor		1000
		$ 5060

406000 5.6955
4.8293
4.8662 7.3 per M

506000 cts 5.7042
675000 4.8293
.9749

9.4 cts per M at consumers

Taxes 2% 2500

250000 5.3979
67500 4.8293
.5686

3.7 cts at consumers
17000 5.2304
4.8293
.4011

2.5 at station

Labor
per day 2 Engineers $ 10
2 Wipers 3
$ 13

7500 lights
25 cu. ft
187500 M

5.1139
2.2729
.8410

6.9 at station

Continued Book 39 p 273

1 ~~tons~~
15

75
3
225
15
1125
225
33,750

cars 18 tons
locos 12
pass 16
46

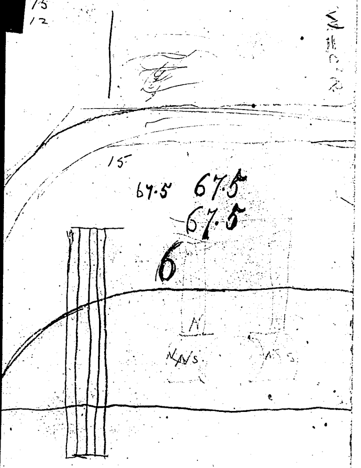
100 feet to mile

46
2,000
9,2,000,00 ft lbs

33) 9.200 (270
66
260
231
9,200,000

(135 H.P.
67 H.P.

15
12



Menlo Park Notebook #50 [N-80-04-17]

This notebook covers the period April 1880-May 1885. The first part of the book dates from 1880 and contains notes on ores received and assayed by Edison and his chemist, Alfred Haid. The second part of the book was used in 1884 and 1885 and contains notes and drawings by John Ott relating to ore milling, along with notes and drawings by Edison, Ott, and Martin Force relating to storage batteries for miners' lamps. The book contains 282 numbered pages.

Missing page numbers: 1-2.

X E-172 N-80.04.17

April 17 1880 3

Recd from Cummings Oroville 2 pkgs - one of pyrites in Quartz which he says there are plenty of 10 miles from Oroville & asks if they would be suitable for making sulphuric acid. Wants report of assay.

Not auriferous. Not fit for burning

The second pkg is bag black sand from Ground of Geo Springer 1/2 mile from Cummings office, Says can control the property. parties would like Know result = Much Gold No Platina

By glass panning 4 flakes gold coated red stuff - plenty mercury & some pieces amalgam

Sand quite magnetic will
see what proportion is magnetic

---

pkg from Thomasville N.C.
Came today -
get result Nothing

---

2 men A W Harris came
on 14th - brought 3 samples
from N.C. one iron - 1 pyrites,
1 mud - address 60 Bowen st
~~Bro~~ Providence R.I.
result only trace g[illegible] in
Each sample =

Mc. Kenzie Bridge
P. C. Renfrow Oregon
Black Sand. Much gold.

W. A. Keeler 24 Street N.Y.
Sends a piece of pyrites in question. Nothing

S. Pinkham 202 West 23rd St N.Y.
Tellarium ore,
from 100 gr. 0.130 gr. gold
= $ 686.4 per ton

W. H. Janos & Co, Room 30
Times Bldg. Chicago.
Black sand containing auriferous pyrites. Gold little but perhaps enough to work it.

From Mathyas, Riverside P.O.
County Colorado
traces gold

U. S. Mining Investment Co
~~Gold~~ Platinum?
Nothing.

16/4 N.Y. & Arizona Mining Co.
Little gold only, not suitable for our process.

20/4 Felix Agnus. Baltimore
Tailings and dry pulps.
Poor result in small scale.
Might be tried in larger scale

Kelton Utah, Plumbago
from W. T. Emery Nothing.

F. Zachert, Sixth St. 1403
San Francisco. Black Beach Sand.
small traces gold

T. M. Newson, in Stillwater, Saint Paul. Coppersulfide traces Silver.

Bottom of Tunnel dry Creek ~~Gravelly~~

3 lbs. sifted out of 8 lbs.

6 6.10
6.. 598
0.012 Gold

0.012 . 2000
3

3 / 24,000 / 8 . . . gr.
per ton

31 gr. = $20

1 8 20.8 / 31 • 31 / 160 / 5.1
155
50

The remai[n]ing 5 lbs. after crushing yield $0.50 ton

$5.100 per ton

H. P. Brother Nothing suitable for our process.

Ellis. Mercury. traces of Silver. No Gold

Bloomfield. 2 specimens the one marked a black sand from North Bloomfield M- Mg. Co. Tunell contains Gold $1½ to the ton.
The other one Nothing.

Newson St. Paul.
Coppersulfide

Delavan Peck, Nelson Gold mine Colorado. Copperpyrites traces gold

Nelson Gold mine County
Ward District Boulder Cty
Colorado, Calavaa Peck
Porphy. Traces Gold

Caldwells store Rastrops Co.
Texas. Mrs T. A. Livingston
Nothing.

Paul Wagner Las Vegas
New Mexico. Nothing.

G. H. Bennett, with Lieut
April 5th 80 Blocksomes, Scouts
Fort Bowie A.T.
Molybdenum sulfide.

Emery, Kelton Utah
Plumbago. No gold.

Boyon Tyson (Gold run Cal.) sends what he
terms "Vegetable pyrites"
The pyrites are not auriferous.
but there is some covered
gold among them, besides
a great deal of amalgam.

F. E. Kinsman 46 E. 14 St
Specimens of Copper pyrites
containg. sufficient gold
to work them

J. B. Ascoth. Pyrites, little gold.

Mr. I. Tyson tailings, gold ore
sent by Mr. L. contain too little gold
to work them.

J. M. Rayburn Corvallis Oregon
different specimens of Copperpyrites
containg. Gold worthwhile to investigate closer. Have no letter.
letter recd

John L. Welch, Ashland
Jackson Co. Oregon.
Black sand. Gold and Hg.
in the form of cinabar.

Dr. A. J. Williams 723 Chestnut St
St. Louis 5 packages placer
dirt from [illegible] Color-
ado. Only very little gold.

J. N. Whitcomb Nothing
Black Sand

Fields, [illegible]
Nothing.

H. Richard May 24 Wat[?] Bridge
Sand only - $352 per ton

No 1 -
F E Kinsman, Sulphurets
wants ~~test~~ =

No 2 W. J. Schuyler
Nevada City, Cal.
Murchie Mine
average ore - some free gold
Copper pyrites also non-antimony
arsenic - Little Tellurium & Selenium -
Silver. 20 pc free gold - Silver
30 pc remainder. 1/3 of 1 pc of
the whole metallic Copper in
form of Copper pyrites =

Tellurgold A No. 1.
500 grammes.

3.612
3.335
0.277 in 500 gr. =

500 : 0.277 = 2000 : x

1.108
12
2216
1108
13,296

0.277 4 / 1.108 # = 13.296 oz
13.296
20
[illegible]
$ 265.9 ton

Tellurgold A No. 2 500 gr.

3.688
3.612
0.076 in 500

500 : 0.076 = 2000 : x
2000
500 / 152000 / 0.304
1500
2000

0.304
12
608
304
3,648

3.648 oz per ton

McLaughlins ores sent May 19
1880 =

No 14 - Henrietta boat, plenty mercury saw no gold, but only used handful of sand on glass = ~~test~~ with Sieve full -

No. 5. Powers Clean up. one Sieve full 1/2 out rest panned + then glassed over 100 small Colors, very rich 1/3, free gold not amalgamated - rusty - rest mercury - all very fine will go ~~through~~ very fine sieve + thus be made very rich -

Mc.L. May 1880

No. 17. Pure sulphurets from Corcorans Mine near Stockton

130 gr. roasted ore = 0.313 Au = $ 1152 to the Ton

451 gr. of this ore roasted down to 301 gr.

No. 8. Lava bed (black sand)
Very rich fine gold no amalgam - small handful on glass 30 colors fine - nearly all magnetic

No 9 — 2 Colors (small).
1 handful on glass - nearly all black sand
Say 70 pc (could be nicely concentrated)

12 - very poor 1 small Color 1/2 pan full — no Hg -
Little black Snd. 5 - pc.

Nov. 8. Mrs L. Lava bed placer sands

500 grammes.

Concentrated	234
Iron	221
Coarse	45
	500

for wet assay took ½ of the Concent. 161 grs. from these obtained 0.003 gr. Golds = 0.447 oz Gold per ton of 2000 lbs.

the same by fire assay

0.5 oz Gold per ton
0.5 " Silver per ton

No 7 – ~~after~~ about 75 pc black sand after sifting about 90 pc. 3. Colors small in ¼ pan full no Hg – ½ of Silver to Gold.

No 6 – 50 pc black Sand – 2 colors in large handful on glass – No Hg –

$$\begin{array}{r} 3840 \\ 575 \\ \hline 3263 \end{array}$$

$$575 \overline{) 3840} \left(6 \right.$$
$$\begin{array}{r} 3450 \\ \hline 390 \end{array}$$

$$\begin{array}{r} 160 \\ 390 \\ \hline 2890 \\ 346 \end{array}$$

No 5 *. $40 to the ton

Total amount 8 lbs — 3840 grammes

sifted to 900 mesh. 873 grams

Lifted magnetically from the 267 "

also

Substract sand lifted by magnet 31

~~Total~~

~~Leaves gold~~

$$\begin{array}{r} 267 \\ 31 \\ \hline 298 \end{array}$$

Substracted from $\begin{array}{r} 873 \\ 298 \\ \hline 575 \end{array}$ — in which

Leaves — 575 — in which is gold.

(1e) total 3840 — sieve + mag leaves 575 grames with gold. or 6½ times concentrated →

No 5 * - one handful of the 575 grams gave on glass 20 or 30 colors + lot of small colors - there was lot of mercury + amalgam - gold has rusty spots or rather a flocculent porous pearly colored reddish yellow - I now put it into a paper box marked 5 * 575 grammes lot - but there is not that amount after my handful was taken out

3840 gr. down to 575
the 575 contain $ 39.8 to the ton

30 . $\frac{0.0025 \cdot 2000}{3.0}$ 0.166
12
1 3 6 2
1 9 9 2 20
39,840

0.0025
2000
30 / 5.0000 / 0.166
20
200
140

No 12 -

Coarse	3700
Sifted	990
Magnetic	18
	4708

Scarcely any if any gold in Coarse

No 14. -

Coarse	1860
Sifted	1885
Magnetic	70
	3815

There is very little gold in this - little amalg ~~+ Hg~~ - gold exceedingly fine -
Coarse no gold some

Dry Creek Tailings

No 3 - 500 grammes taken =

There was lifted by magnet from this - 190

Leaving 310 grammes containing the gold - a curious thing is the iron magnetic is black, I found that a stronger magnet took out more, & I think a very strong Electro mag would take out still more.

30 gr. yield 0.005 gr. gold = $80 per ton
+ 1.5 milligr. Ag 1.2/10 ounces Ag per ton

No 3 Regular No

From R C Welch,
Redwood California,
Pkg. says can obtain millions
of tons -
OK
2/3 of this is magnetic - it is very
rich in exceedingly fine shot
gold just the thing for our
magnetic process.
~~Dett~~ little bag was empty when I got it

No 4- Black Sand from 4/10 oz per ton gold
Ed
J. J. McMillan Paris Ky
80 pc magnetic Rich in gold
but it was in amalgam ask
them where Hg came from
OK

30

No 5 =

John D. Daley -

Newport, Benton Co

Oregon -

OK

Beach Sand, black, 1/4 - Easily lifted by magnet, 1/2 by an Electromagnet & 95 p c by large Electromagnet, Contains Hg & pbly amalgam also exceedingly fine scale gold finer than eye of needle probably be just the thing for our magnetic process of ore can alter trajectory of weak Magnetic particles

Over

31

He says away from the
beach there is lots of black
sand streaks - promises to
send more samples also a
sample of what they call
platinum = write him say we
can work the pure black sand
as per sample without water,
but much white sand in black
Sand is fatal to Economy
of the process, Very little Gold only traces.
1/5 oz silver

3X

No 6

From H Rickard Gold $ 35.2 ton

OK Fort Bridger.

Black sand. looks like Oregon sea sand but finer =

40 pc magnetic = Extraordinarily rich in flour gold perhaps in 1/2 handful on glass there were 5000 colors say 300 milligrams gold

write for particulars how it occurs quantity etc = No Hg.

ask if sample was panned down — amalgamates readily with Hg —.

36

CA Dickerson
Lodi, California (7)
San Joaquin Co -
small sample gold
some large 1/16 across good deal
flour gold -
says he sent 2 pkgs - write
we only recd small paper
write him to send 3 lbs
clay also 3 lbs gravel
~~from both beds~~ by mail,
it goes as 3rd class matter
say that the best process we
have ~~lbs~~ for working
auriferous black sand
containing flour gold say
be sure to put name on
sample

38

Sample from No_8 39

J M Riggs

Dos Cabezas

Arizona Territory

no Letter - its quartz with

few Scales of pyrites -

no use ~~to us~~ -

W C Ingles, No 9

Knoxville Tennessee ~~Nothing~~

OK

No 6* McL =

1336 — altogether.

Coarse —	874 —
Magnetic	185 —
Containing Gold	277

handful on glass gave 2 large scales, and several microscopic colors, only little Hg = about 50 grms more could be taken out with strong magnet.

No-6 — Some Silver too small to weigh — traces gold —

No 7* McL

Altogether.

Coarse	700
Magnetic	246
Goldiferous	219

2 Scales gold - considerably
Hg: about 50 grammes more
magnetic could probably be
taken out with [illegible]

Dr H. 7. 1/2 oz. Silver Traces Gold

No 10 – Sturgis –
Tailings =

Mostly fine = but mixed with
1/8 + 1/4 inch quartz pebbles –
poor only 2 large & several
small colors per 1/2 pan = considerable
pyrite = Don't think it would pay
Except concentrate with water =
Clayey = ~~DrH~~ = No gold – 1/2 oz Silver per ton

No 11 Quartz (Brownish) from
Sturgis = Crushed & panned
is rich in gold – fine, plenty
pyrite = Mostly free gold somewhat
coated with the yellow stuff –
there is pyrite little & another
heavy sulphide somewhat
malleable = probably could
be worked ~~together~~ Roasting
J. W.

No 11 Calamine
Hairds assays & find
fine part 3 oz gold per ton
coarse part 1/5 oz " " "

No 12. Ad - Mailliard
San Rafael. Marin Co
Cal -
Nothings, but 2 pieces gold
by glass: Dr H assays it -
has lode 3 miles 50 x 40 -
Rebellious - will send 100 lbs wants
make arrangement with me = let him
Know result, Hairds assay
small traces gold

Sturgis
Large candle box
full Red Tailings

D. H. = Only traces Silver & Gold.
OK

Steele, Santa Barbara Co.
D. H. 2 oz Silver per ton no gold

Waters - San Francisco -
D. H. = 3 oz Silver per ton - OK

Rapp - County Clerk of Chicago -
D. H. 122 oz Silver per ton
Trace Gold
OK

~~C. P. Geer~~ No 13

Scottish Mining & Smelting Co
Salina, Boulder Co Colorado
Sample of crushed & roasted
telluride ore, wants us try
our hand at it =

2.8 oz Gold
1.2 " Silver.

OK

No 14 — 1/2 oz Gold
1/5 Ag.

Black Sand from
Plumas Mining & Water Co
Plumas Co.
Spanish Ranche
California

OK

~~no free gold~~ has some
mercury & probably some
amalgam — there are several
pieces silvered by go
Hg — would pay us
splendidly if it was as
good as sample as it is
nearly all magnetic
large grains —

54

No 15 = 3/8 oz. Gold
1/8 " Silver.
In box - no name -
~~Slate~~ with pyrites -
has letter with address
of C A Bulkley Esq
Granville Washn Co
ny
Postmark from Hartford Conn

56

No 16 = 1 57

Tin box blacksand

from ______ Seal on it.

Harkness Bankers

Ogden Utah =

no free gold has Hg pbly

amalgam - Dr H says

little gold - its good

sand for magnetic process

TL

No 17

Pkg from W N Dennison
Sparta
Union Co.

O.K. Origin

Good magnetic Sand
Rich in gold first
Class for our process -

Dr H = Rich in gold but too little
material for quantitative assay

No 18 36 oz. silver per ton
4/10 gold per ton.

Newton Dungan
Postmaster

OK Tooele City Utah,

Tin box of ores, look like Copper
ores - 36 oz silver per ton [illegible] gold

No 19 — Long box, 3 compartments
1 2 & 3 = No 1 - Mill Tailings - No 2
Tailings mixed with Quartz Stone
No 3 - Some Rock also Earth =
from Young Stockton son of
Com Stockton Trenton N.J.
from the South = pyrites = considerable
very fine gold - about like
Cons Virginia Mill Tailings = very
Little amalgam & ~~Hg~~ = we could
do nothing with the Earths
except perhaps our Chlorine
phoned work, am trying it now -
Dr H will assay the rock =

Sayre = No 20
Danbury Conn

Same man that had tungstate
of Lime = Wants assay –
only Traces of Gold &c.
The last one in bag also

66

No 8 McL. Lava bed #3. 67

Concentration:

500 grams, all —

221 - Magnetic.
234 no magnetic
45 Coarse
500. -

assays - non mag. 0.447. oz
per ton gold - wet =
Same by fire assay 1/2 oz gold
1/2 oz Silver =

221 magnetic assayed
gold. 0.0015 gramm - gold
probably picked up by particle.

68

3.45

No 21 69

José M Villa

Care of D de Castro & Co

54 William St

OK

pyrites - heavy -

1 specimen 6.4/10 oz ag per ton

1/10 — oz gold

No 2 - 1/2 oz ag - 1/10 oz gold

No 22

Mackay - Comstock Tailings

3 7/8 oz Silver $4.45 - Silver

1/8 oz gold. $2.60

$7.05

No 23

Husbands

7 samples —

Everyone of them contains Gold and Silver but only in small quantity except No. 2 which is a little richer amounting to 1/8 oz of Gold per ton

OK

No 24 Pure Blacksand from H Stuff. Lambs Bridge California, Enormous quantity of platinum 1/4th of Entire bulk some gold. no letter See about this, plat nuggety =

OK

25 =

Bag, sand from W C Martin

From San Francisco OK

Dr H = 1 1/4 silver - 3/4 oz gold ton

not enough magnetic for us - ask for full information

26 - Hall. from Taryall Colorado

Bag concentrations ~~&~~ Mother gravel.

neither rich, Mother E. has some

Hg & amalgam - Scarcely any

black sand its good hydraulicking

gravel will assay for Silver

OK

27. F E Matteson.
Danville
Contra Costa Co
Cal.

Sends 25c return postage, register letter result assay = little pkg black sand & 3 or 4 rocks, in tin box - letter in it, sand requires strong magnet =

28
A. W. Barnard. ~~Butte City~~ Montana
Black Sand - nearly all magnetic
Very rich gold - just thing our process - gold fine & very rusty
saw Hg in it it must probably be
Concentrates - Sand requires strong mag ~~dist~~ 14 oz gold. 18 oz silver.

76

77

29 — ① S Justice " Azusa Los Angeles Co- California ~~Azusa~~ ~~whereat~~

OK

Black sand. very rich nearly all magnetic, just thing our process. DrH 2 oz gold 3 oz silver.

Louis Glass, Oroville — Black sand 1 oz gold to ton = OK

His pyrite contain nothing

Farrel Mine.

No 3. Eureka Lake & Yuba Canal Co Consolidated 65 Pine st NY

Very rich in leaf fine gold saw little Hg - all silica white clean. looks clayey think its been sifted - 1 handful 8 colors

---

No 4 - Farrell. Ferric colored sand Hg - quite rich in gold 1 handful on glass 10 colors

---

No 2. Lots amalgam 2 or 3 pieces fine gold -

George Carman

Ashes from Corbier's claim

Also Tailings from ———

Ashes, 1/4 oz gold. 3/4 silver. Fire a.

– make wet assay –

Higbee man with mexican,
placer sand - 4 oz gold 3 oz.
Silver - per ton OK

Hedden OK 4 4/10 - Silver 1/10
oz gold = OK

DrH No2 1 1/2 oz au
35 oz Silver
(DrH = 1 oz au 33 oz
Silver - No1)
from G W Bennett,
pkg ore - Postmark obliterated
looks like. APACHE PASS.
apache
TERR
Bowie
Arizona Ter

Plumas Mining & Water Co
2nd sample - Black sand
= perfectly pure black sand Exceedingly
rich in gold some free in scale but
very rusty & unamalgamitable & some
~~are~~ frosted with Hg but quality

Sticking to gold so it cannot
~~not stick~~ together to form
amalgam - A beautiful
Sand for our process. Dr H
will make fire assay -

Bag of Iron Sand and Concentrations
in shot bag marked from
Forbestown, there is lots of rusty
gold + quartz (yellow red) coated over
with filamental gold - It is Enormously
rich =

Bag with 2 samples from
Baker City - Sent through Kountz
Bros -

3 pieces Rock from H.G. Maynard Cheyenne Wyoming Terry (Clark) said to contain platinum — assay for Platinum Gold & Silver —

Quartz from W T Danner Burlington Iowa — said to contain platinum

---

Woodstock (Me. [illegible]) — Black sand from a Brook (Letter) address for information ~~[illegible]~~ ~~[illegible]~~ Mrs Dow 30 Upton St Boston — Very Rich in Gold

Ore from John Bowman.
Princeville Peoria Co. Illinois

J. F. Ott   May. 14. 1884

Made large Electromagnet and suspended between its poles. extensions with silk fiber the following Mettals and compounds

Ivory is directed with the lines of force without nearing eather poles while suspended in cent ~~the moment atempted~~ to draw out of line it neared the nearest pole

Aluminum across the lines of force provided it being suspended direct in cent of lines of force, but by drawing it out of the lines of force, it nearing one or the other pole

Mt Quartz acted the same as Aluminum

Glass the same as Aluminum

Sulf Iron with the lines of forces otherwise acting same as Aluminum haveing a slight stronger mag force

Zinc with the lines of force but atracted by the magnet when drawn out

Mica with the lines of force but atracted when drawn out

Lead set itself up with the lines of force but was not atracted by eather pole

Elder Pith with the lines of force and atracted when raised or lowered below cent lines of force

Gold with the lines of force, on being drawn out it neared eather one pole or the other

Filled ~~with~~ small glass oblong bulb with Muratic Acid it tuck up its position across the lines of force when drawn out it neared the magnetic poles J. F. Ott

Filled small oblong glass bulb with sulphuric Acid and suspended it. and acted same as Muratic Acid

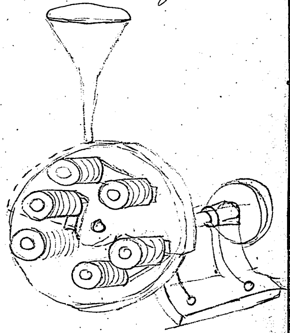
Acedic Acid the same as Muratic Acid

J. F. Ott.

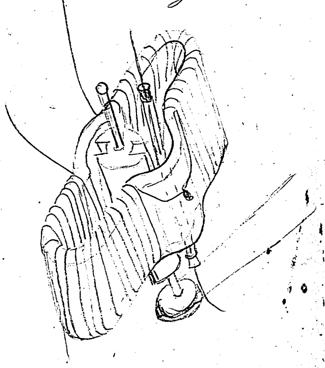
May 16, 84,

Made model for Ore Milling

J. F. Ott



98 One Milling suspended small piece of copper in glass tube J. F. Ott



Solutions used in Storage battery experiment for Miner's Lamp.

#1
#2 Red Fluid
#3 ~~Bisulphate of potash~~ Hyposulphite of Soda
#4 ~~Hyposulphite~~ nitro prusside of Soda
#5 ~~Cyanide~~ " " " + Phos. acid Glac.
#6 Manganese sulphate.
#7 ~~Potash Ferro Cyanide~~ Mn Cl
#8 Phosphoric Acid.
#9 Mangan + Zinc sulphate.
#10 Glacial phos. Acid.
#11 Hyperoxydat mangan + glacial phos. Acid
#12 Oxide Zinc + glacial acid.
#13 Mangan sulphate + glacial acid
#14 Ferric Cyanide.
#15 Boracic Acid.
#16 Mangan Carbonate + glacial acid.
#17 Stannate Soda.
#18 Phosphate Soda.
#19 Soda acetate
#20 Acetic Acid.
#21 Acetic Acid + phosphoric acid glacial + water

#3[?]2

\# 23 Arsenic Acid strong
\# 24 Sulphate of Zinc + Sulphate Iron.
\# 25 Citric Acid.
\# 26 Sulphate of ammonium & Sulp of Zn
\# 27 Oxalate In " " & Ph. ac. Glac.
\# 28 Pyrogallic Acid.
\# 29 Tanic Acid.
\# 30 Do Do + phosphoric acid gla.
\# 31 Glycerine + Common Salt.
\# 32 Do + Sulphuric Acid.
\# 33 Do + Phosphoric Acid Glacial
\# 34 Oxalic acid.
\# 35 Do + Phosphoric
\# 36 Tartaric Acid.
\# 37 Do Do + phosphoric Acid (Gla)
\# 38 Alum
\# 39 Do + phosphoric Acid.
\# 40 Do + Manganese Sulphate.
\# 41 Ammo. Sulphate of Iron + Zinc Sulphate
\# 42
\# 43 Arseniate Manganese + Zinc Sulphate
\# 44 Barium Chloride
\# 45 Do Do + Manganese Chloride
\# 46 Sulphate of Iron
\# 47

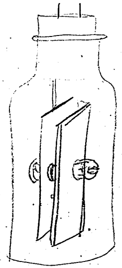
cont'd

April 13 1885

T A E Wm M. Force

Experiments on Storage Batteries for Miners Lamps

Lead Electrodes inch wide. 3 inches long + $\frac{1}{4}$ inch apart. $\frac{1}{16}$ thick



48 --
49 --
50 - Carbonate of Potassium
51 Bi - "
52 Sulphate " -
53 Bi " " "
54 Bromide of "
55 Permanganate " "
56 Sulpho-cyanide " "
57 Ferro-cyanide - -
58 Hypo sulphite " "
59 Arseniate of "
60 " " " + Phosp. Potass

Storage Continued April 13 1885

T A E
M N Force

No 1

Lead & Lead - Ordinary Red fluid Bichom —

3.35 PM. April 13. deflection on strap 50 - By mistake 3 cells chrgg was used for 2 mins. now changed - defln 27 strap At 345 - disconnected & put through 2 ohm Coil gal - gave 50 then down to 10 in 10 seconds 20 seconds gave 4 - N.G -

No 2

Lead & Lead - Chromic Acid + Sul acid -

22 on strap 348 pm — ~~pol~~ in 10 seconds 15 = Chrgg with 2 Bichom Cells — 30 seconds goes to 11 on strap = stays at 11 - Disconnected at 358 — 15 on 2 ohm coil in 3 seconds 10 in 5 seconds 8, 5 in 20 seconds - N.G.

104

Storage Continued April 13 1885 ~~pg~~ 105

M.N.F.

No 3 —
Lead & Lead — Strong Solution Bisulphate
Potash = at 4.02 pm — strap gives
8 deflection. ~~stays there~~ same
defl at 4.05. disconnected at
4.12 pm — ~~in~~ in 2 seconds 10 deg
on 2 ohm coil. 8 seconds 5 deg.
20 seconds 3 deg = Reversed & Rd deg
4.14½ PM. 8 deg on strap — at 4.16 — 10 on strap
at. 4.20. = 2 seconds 12 — 10 seconds 5 on 2 ohm coil

No 4 Phenomenon
Lead & Lead Hyposulphite Potash,
On at 4.33 — pm — def on strap 6.
Solution almost instantly turns
black at top. in one or 2 seconds ~~strike~~
this black clouds so thick that by
shaking bottle its almost like ink,
pbly go fluid for chemical telegraph,
one Lead pole coated heavily with
white substance, viscous & dont rub off
= perhaps sulphur. deflection at 4.41
2 on strap — this coating evidently
insulates. off at 4.42 = in 2 seconds 8
on 2 ohm coil. in 30 seconds 5 on 2 ohm coil
1 minute to 3 on 2 ohm coil ~~=~~

MNF

5 =
Lead + Lead - Cyanide [illegible]
On at 4.24. gives 12 on strap.
off at: 433 - 10 in 2 seconds.
3 in 5 seconds 1 in 8 seconds

6 Sulphate Manganese
Lead + Lead - on at 445 — Strap 4
deg — 4 deg at 455 — off —
30 deg 2 secs — 15 at 5 secs —
30 seconds 10 deg — 60 secs — 5 deg
on 2 ohm coil — 3 minutes 3 deg
on 2 ohm coil -

108

April 13 1885

No 6 Continued

Lead & Lead

Tak 09 M.M.T.

In discharging found that bright plate got blackened (i.e.) aparently the discharging re-charges it thus giving C EMF & poor results. the peroxide black after discharg appears as black & think as it was bey discharging I now reverse direction at 5 oclock something peels off in flakes & drops to bottom - defln on strap 4 deg - off at 5.05.

2 seconds 30 5 seconds 20.
10 seconds 15 - 20 seconds 11
25 seconds 10 - 30 sec 9 - 35 sec
8 - 40 seconds 6 - 50 seconds 5 -
1 min 5 - added strong Sul acid - Rechgd - 5.15 pm -
Rechg - The Sul a. cleans plates & dissolves the flakes at bottom - defl on strap 12 -

over

April 13 1883 ✓11
Edg
M.N.F.

6 Continued Lead & Lead

at 5 20 - strap gives 20 deflu -
off at 5 20. 2 sec 20 5 seconds
15 - 10 sec 10 - 15 seconds 7
~~20~~ seconds 6 25 - seconds
4 - 30 seconds 3 -

No 7 - Lead & Lead
Ferrocyanide of Palasium
acidulated slightly with SO_4
Strap - 5 - at 5.24 pm -
at 528 - 7 def - off at 530
Deflu "2" on 2 ohm coil S S
N.G.

April 13 1883
Tac.
M.U.T.

Lead & Lead

No 8 — Double Sol Sul Zinc & Manganese 5,34 pm —

Strap def - 10 deg —

5,44. off 5 secons 70 — on 2 ohm Gal.
10 secons 60 — 15 secs. 50,
20 seconds 45 — 25 second 35 —
~~60 sec~~ 1 min. 32 — 1 1/2 min
30 — 2 mins - 23 —
2 1/2 minutes, 19 — 3 minutes, 15 —
3 1/2 minutes. 14 — 4 minutes. 12
4 1/2 minuts 11 — 5 minutes, 10
5 1/2 minuts. 9 6 minutes 8.
6 1/2 minutes. 8 7 minutes. 7.
8 minuts 6 — 8 1/2 minutes. 6 deg

April 13 1885 — Tag

No 9 Lead + Lead, Hypophosphate ~~m of Fine~~
soda 6 pm: 4 on strap one
plate turns Blacks almost instantly,
off at 609 — Runs down instantly
to 2 on 2 ohm coil & zero in
10 seconds —

April 14 1885 —

10 - glacial phosphoric acid.
Lead + Lead — 1151 AM. 12 on
Strap. 1155 — 10 on strap —
at 12 M — 8 on strap = off —
1 sec 15 — 5 sec 10 on 2 ohm coil
notice peroxide very brown not black
as usual, 1 minute 9 — 1½ m 6.

116

Apl 14 1883 — TAE 117

10 Continued, Reversed direction & put on at 1203 — 8 on strap off at 1212. 1 sec 25 — 5 sec 15 — 10 sec 10 — 1/2 min 10 — 1 min 8. — 2 mins 6. — 2 1/2 — 5 = Every bit off the peroxide reduced plates. perfectly clean after discharge this seems to be big advance over SO_4 — Zero in 3 mins. This should be investigated by constructing large battery

after white White powder falls bottom cells — Bad

No 11 —

Lead & Lead — Strong Sol. Red Prussiate Potash. Strap "24"

Violent action - precipitate in great volume falls from plate Connected to Carbon pole — 1225 PM —

off at 1226

11 Continued, on 2 ohm first zero then rises to 5 — then 3 — precipitate is a yellow — voluminous

12 — Glacial Phos Acid strong Lead + Lead saturated with Hyperoxide Manganese, Blue Solution, Hyper is green white powder — this probably makes phosphate manganese — 20 on strap
1247 pm — Both plates Browned one very strongly other weakly Stands at 20 on strap right along — on shaking few flakes Brown stuff falls to bottom, perhaps too rapidly charged off at
1253 = 13 on 2 ohm coil 5 seconds 10 seconds 24 — 30 sec 20

The Hyperoxide is only a Copper salt put in bottle by mistake

12 Cartonned, 1 minute 19 –
1 ½ min. 18 – 2 min 17 –
2 ½ min. 17 – 3 min 17
3 ½ minute 15 – 4 min. 14 –
4 ½ min. 13 – 5 min. 11
5 ½ min. 10 – Reversed
direction [illegible] 20 – 1259.
off 104

Phenomenon

at first sends powerful opposite current as it should do but this almost instantly stops runs to zero & gives for instant 50 in opposite or same direction as Chg battery this gradually runs down as above – 1 minute 20 [illegible] 2 ohm Coil

April 14 1885 — Th 2 3

No 13 — Mixture of a Copper salt ~~glac! phos acid~~
+ Hyper Oxide Manganese —
also of phos acid + oxide Zinc
15 on strap. 1.13 pm — in 1 ½
mins 15 on strap — off at
117 — same phenomena of
Reversals — 30 on 2 ohms
in 5 secs 20 10 secs 15
20 sec 15 — — 25 sec 12
30 sec 12 35 sec 12.
60 sec 12.

124

Lead+Lead 125

No 10 - Changed - phosc acid glacial & sol Sul Zinc -

133 pm - Strap 6 -

1/2 minute strap 9 - Carbon plate dont seem to Blacken - I guess Sul a liberated there dissolving the peroxide manganese;

off 135 = 90 on 2 oh

Coil 10 seconds 82 - 25 seconds 60. 40 seconds: 35 - 45 25 - 50 sec 20 53 sec 18. 57 sec 15 - 59 sec 10 - Rapidly goes down Recharge.

138 pm - strap at 1st 35 Rapidly goes down to 5 - Solution becomes milky probly from phos Zinc, strap in 1 min 10 -

1 144 off 95 - 10 sec 90 · 20 sec · 90

April 14 1885 T A 9.27

30 sec 90 - 40 sec 90 - 1 1/2
50 - 90 - 1 min 90 2 1/2 min
90 - 2 min 80. 3 1/2 min
70 - 3 min 60 - 4 1/2 min
47 - 4 min 35 5 1/2 min
24 - 5 min 18 -
~~[illegible]~~ 12 - again put it
on with same free 504 -
Strap 1.50 pm 10 - Liquid very
white cloudy - 157 off
almost right angles, more than 90 deflec
1 min 70 - 2 mins 55 -
3 minutes 38 -

April 14 1885 — Tab 2

No. 14 — Lead & Lead Sols of Sul Manganese & glacial phos acid —
215 pm strap 7 — 1 min
strap. 10 — off at 224

at 1st 80 — 25 in 10 seconds.

20 sec 15. 30 sec 10 — 40 sec 5 —

No 15 — Lead & Lead Boracic acid —
2.32 pm. 2 on strap 236 off
Zero — ng

130

April. 14 1885 - TAEB /

16 - Lead & Lead -

Carb Manganese dissolved
in glacial phosphoric acid
on at: 2 48 pm - 5 on strap

~~off at 251 - 50 on 2 ohms~~

~~1/2 min. 50 - 1 min.~~

off at. 253 off 5 on
2 ohm runs right to zero

17 - Lead & Lead Stannate Soda -

on at 258. 20 on strap
1/2 min 16 on strap. 1 plate Clean
other brown very quickly - 304 off
to 7 almost instantly -

18 = Lead thead Phosphate Soda
.6 on strap 1120 AM –
off at 1126 instantly runs
down to 5 in 5 seconds to 2
& then zero ng.

---

19 – Lead thead acetate Soda –
34 on strap 1129 – AM.
Precipitate forms rapidly as
Hydrogen eliminated, Electrodes
dont seem to have peroxide on
but grey lead – 1132 AM. 30 on
strap – off at 1134 AM.

55 on 2 ohm coil 10 sec 40 20 sec
25 – 30 sec 20 4.0 sec 15 –
50 sec 10 $1\frac{1}{2}$ min 8 – Enormous
precipitate –

Continued

20
Lead Thread. Acetic acid,
11 37 AM - 3 on strap - High
Resistance. Off at 1143 nothing

21 - acetic acid phosphoric acid
glacial Water 15 at 1st on
strap goes in 3 seconds to 4
11 45 AM. off at 1150.
50. 10 sec 40 20 sec 37
30 sec 32 - 40 sec 30
40 sec 27 1 min 22
1 $\frac{1}{2}$ min 20 2 min 15
2 $\frac{1}{2}$ min 4 -

23. Lead & Lead.
Arsenic acid string
Conc — 15 on strap 1153 am.
gas comes off both plates.
1154 20 on strap
1201: off scale 10 sec 85
20 sec 50 30 sec 57 — 40 sec
55 — 50 sec 55 — 1 min 50
1½ min 35 2 min. 15
2½ min. 10 —

---

25 Lead & Lead.
Citric acid. 5 on strap
1206 pm — 1207 — 4 on strap.
1211 off — 5 — ng

April 15 1885 TAE

---

28. Pyrogallic acid + Salt, lead thread

130 pm - 2 $\frac{1}{2}$ on strap

153 - pm - 5 on strap

---

29 - Tannic acid + Salt

20 at 1st 2 seconds 4 on strap. 157 pm - 2 pm 3 $\frac{1}{2}$ on strap - off at 205, 20 on 2 ohm - 5 seconds to 5 - ng -

---

April 15 1885

30 Tannic & Phosphoric glacial.

206 pm 25 at first in 10 sec
8 on strap off 212 pm 50 -
10 sec 35 - 20 sec 29 . 30 sec
14 - 40 sec. 10. 50 sec
8 -

FROM THE LABORATORY OF
T. A. EDISON,
MENLO PARK, N. J.
U. S. A.

142

April 15 1885 TAE 143

31 — Lead & Lead
Glycerine & Common Salt.
229 pm - 10 on strap -
20 sec goes to 3 on strap.
234 pm off 10 in 10 sec 7
20 sec 5

No. 31 Solution Zinc & Copper
Carbon to Copper 7 on strap
530 pm — 5 32, 5 on strap.
Shaking goes to 7 — —
off at 5 37 pm — off scale.
1 minute 85 — 2 mins 50
7 mins 7 on 2 ohm
Coil. I reverse putting
Carbon pole to Zinc
30 on strap —

144

April 15 1883 Tas

31 Continued
5 45 pm. 30 on strap off
at 5 48 ½ pm. Zero
ng

No 20 - Acetic acid Zinc + Copper - Carbon to Copper -
3 on strap 5 51 pm - off at
5 52 ½ Zero - plates
Zinc on Copper Reversed
poles Carbon to Zinc
3 on strap - 5 53 pm -
off at 5 54 - 10 on 20 ohm
ng -

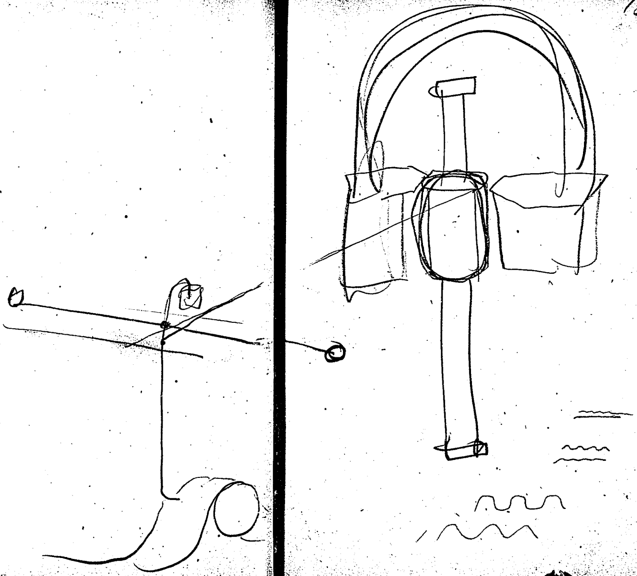
No 10 – Copper + Zinc –
55 – on strap Carbon to Copper
enormous lot bubbles from Zinc
blue vitrol thrown down from
Copper – 1 mm charge –
off scale. stays there its
primary battery very
strong but Local action
Enormous

15 Boracic acid ng with
Copper + Zinc

148

149
30

NO 14 — Copper & Zinc.
on strap. Carbon to Copper —
Blue vitrial Comes down
off after 2 mins.
offscale. Local action considerable
on zinc. stays above 80
for over minute stays there
right along — evidently primary
battery = 9 reverse put
Carbon to Zinc. 40 on strap
1 min charging —
~~Che~~ offscale goes 90 & over
& gradually gets strong
Evidently a primary
battery ng



April 17 1885

Experiment with 10 Lead
plates $\frac{1}{16}$ inch apart. 5 × 5
square perforated in strong
Solution of Sulphate Manganese
& Sul Zinc: Deflection
on strap 22 at 1 40 pm —
at 155 — put it on short ckt
through strap — 70 defln
on strap in 1 minute 55 —
in 2 mins 35 — in 3 min
24 — in 4 mins 13,
put on at 2 pm — defln 50
in 1/2 min 35 — one min
22 —— 2 mins 17.
after 8 minutes 14 on strap

At 240-pm put in
small 1/2 c p Lamp
Bright red – Dropped to
dull red in 1 minute
in 3 mins below visible
Rechgd at 245 pm 9
Go down Town –
at 730 pm on return
strap shows 10 – I now
put small lamp on 1/2
C.P. through strap &
note, Have no watch must
guess deflection 15 – on strap
other way – Lamp Yellow red

158

157

by clock in other room to 738 pm when I put Lamp on. Strap 13 Lamp little dulled but still yellow 2 minutes afterward
at 756. Lamp Red,
Strap 10. below red at 830. — 9 oclock pm
20th Reversed direction of potation for charging all night
My impression is that this form is no good
[illegible]

158

April 22 1885 TAE 159

Solution of Sul Zinc & Sul Manganese

Tin & Zinc - Carbon of battery

to Tin - Strap 17 ~~1150~~

1145; AM - 1148 off

80 - falls rapidly to 50 40 30

20 15 10 8 in 20 seconds

I now reverse - putting Carbon

of battery to Zinc 22 on

Strap. ~~2 ——~~ 1 min

16. nothing

Zinc & Nickel in Sol of

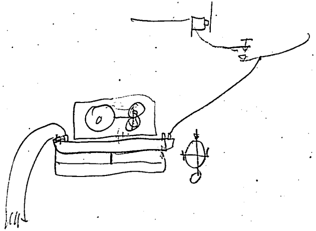
Sulphates of Zinc & Manganese

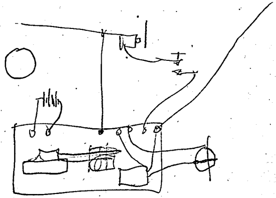
1153 - 8 on Strap

after 3 min 20 on 2 ohm

Coils runs down to 0

in 1/2 min ng -





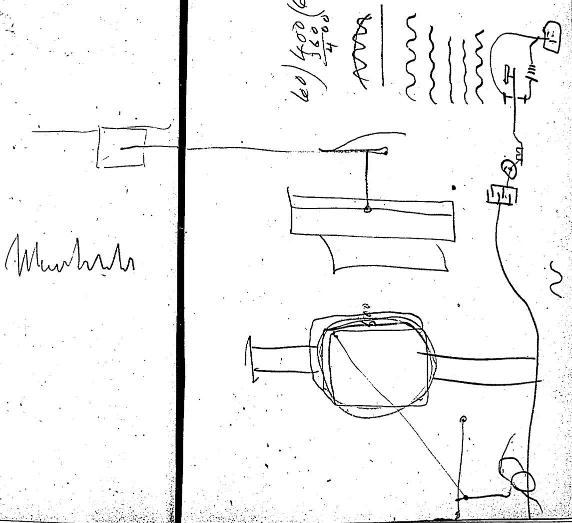
April 24 1885. T.A.E. —

Carbon + Zinc — Sol of Sulphate of Manganese + Zinc — 838 pm — strap 10 at first 5 after minute — off at 852 — just off divisions on 2 ohm Coil in ~~1~~ 1 min: 70 — 2 minute 45 — in 3 minutes; 34 — 4 minutes 27 — 5 minutes: 23 — 6 minutes; 19 — 7 minutes ~~at~~ 19 — Shaking causes it to go up — 5 or 6 degrees, 8 minutes — 17 — 9 minuts 14 — 14 minutes, took it no further

Recharged at 903 pm strap rapidly drops to 10 14 ... then thrown. —

April 24 1885 —

on minute or so goes to $6\frac{1}{2}$ T
on strap — great deal of
gas bubbles formed —



27th Apr. 1884
W. W.

Storage Batteries — Lead & Lead

Solution #36 — Tartaric acid &

Battery only Step Coil Right	Left	Cell only	Readings on Time	Strap Coil	3/10 ohm Coil
35	35	0	3:05	3	
			:15	2	
			:30		25
			:40		20
			:50		11
			16		
			10		05

Solution #34 — Oxalic acid

		nothing	3 23	15	
			33½	3	
			33	2	
			10 seconds		8
			20		4
			30		1
			40		discharged

Solution #39 — Alum & Phosphoric acid

		nothing	35½	4	
			36	3	
			45½	2	
			8 seconds		20
			10		8
			20		5
			30		3
			40		
			45	discharged	

Remarks

Gas evolved in small quantity
No precipitate
No coloration

Gas evolved
No coloration

No coloration
Gas evolved freely

 Storage Batteries – Pb & Pb

Solution # 37 – Tataric & Phosphoric acid / Sheri

Battery	Cell	Time	On Strap	On 3/10 coil
38 & 39	nothing	3h 53m	11	
		53 1/4	5	
		54	2	
		4h 03	2	
		3 seconds		70
		10 "		30
		20 "		18
		30		17
		40		23
		50		23
		60		23
		90		20
				14
		2 minutes		6
		10 seconds		5
		20 "		5
		3 minutes		5
		30 seconds		5
		4 minutes		5
		5 "		4
		6 "		3
		7 "		2
		8 "		1
		9 "		discharged

Remarks

Gas from one plate (negative

Positive plate turned dark brown immediately.

no precipitate

Brown coating entirely off at 9 minutes

no gas from either plate

 #37 Repeated — Pb & Pb

Battery	Cell	Time	On Stop	On Coil
37936	nothing	4 19½	4	
		20	2½	
		23	2	
		29½	2	
		4 seconds	80	On coil
		10 "	23	
		20 "	18	
		30 "	18	
		40 "	20	
		50 "	22	
	1 min	60 "	22	
		10 "	20	
		20 "	18	
		30 "	13	
		40 "	11	
		50 "	6.0	
	2 min	60 "	5	
		10 "	4	
		20 "	4	
		30 "	4	
		3 minutes	4	
		4 "	4	
		5 "	3½	
		6 "	2½	
		7 "	1½	
		7½	discharged	

Deposit immediately formed on positive plate
Gas evolved from negative plate.

No flaking or precipitate.

Charging & disconnecting:
the deposit becomes dissolved.

all deposit off

Storage Batteries Pb & Pb

 Solution # 38 alum

Battery	Cell	Time	On Strip	On Coil
37	nothing	3h 24' 00"	5	
		20"	1	
		34'		
		4 seconds	1 70	On 1/10 coil
		10 "	10	
		20 "	9	
		30 "	7	
		40	6	
		50 "	6	
		1 min	5	
		10 "	5	
		40 "	4	
		2 min "	4	
		2 1/2 "	3	
		3 "	2	
		4 "	1	

Solution # 40 — alum & sulphate of Manganese

Battery	Cell	Time	On Strip	On Coil
38	not priming	5 44' 10"	7	
		5-4	1/2	
		5 seconds		30
		10		9
		20		5
		30		4
		40		3
		50		3
		60		2
		2 min		1

Remarks

Gas evolved

Dark deposit slowly formed

Deposit remains on plate (+)

Slight coloration immediately

Little gas.

Dark deposit formed like previous test.

Deposit remains after discharge

 Storage Batteries Pb & Pb
Solution #44 – Barium chloride

Battery	Cell	Time	Strap	Coil
	nothing	5:55	7	
		1/4	1/2	
		6:05	1/2	
		4 seconds		20
		10 "		6
		20 "		4
		30 "		3
		40 "		2
		50 "		2
		60 "		1 1/2
		70 "		1 1/2
		1 min 30		1
		2		1

very little gas
no deposit or coloration
of solution

 28th apr.
Storage Batteries – Copper & Copper
Solution #10 – Glacial Phos. Acid

Battery	Cell	Time	On Strip	On Coil
358 45	nothing	8:44	23	
		:45	20	
		:54	14	
		5 seconds		23
		10 "		18
		20		10
		30		9
		40		7
		50		5
		1 min		4
		" 30 sec		3
		2 "		2

Solution #22

Battery	Cell	Time	On Strip	On Coil
	nothing	8:59	11	
		9:01	9	
		:09	6	
		4 seconds		60
		10 "		38
		20		27
		30		18
		40		16
		50		13
		1 min		11
		1 " 30 sec		6
		2 "		2

Rapid evolution of gas with discoloration of copper

Dark brown deposit or coloration on one plate & gray on other, no precipitate.

Deposit remains after discharge

Gas evolved but very little discoloration of plates.

Coloration black

 Solution #11 Copper & Copper

Battery	Cell	Time	
28	nothing	9:15	2 on strap
27		20	
		5 seconds	4 on coil
		10 "	3
		30	1

~~#18 Phosphate of Soda~~

Battery	Cell	Time	
	nothing	9:28	1 on strap
		:38	1
		5 seconds	4 on coil
		10 "	2
		30 "	0

Solution #15 - Boracic acid

Battery	Cell	Time	
33	nothing	9:43	nothing
4 35		:53	..
		10 seconds	2 on coil
		20 "	0 ..

Solution #25 - citric acid

Battery	Cell	Time	
	not priming	9:55	3 on strap
		:56	2 1/2
		10:05	2
		5 seconds	36 on coil
		10 "	30
		30 "	10
		50 "	3
		1 min.	1

Dark red color on one plate

slight coloration of plate

No coloration -

Slight amount of gas liberated

Both plates slightly discolored

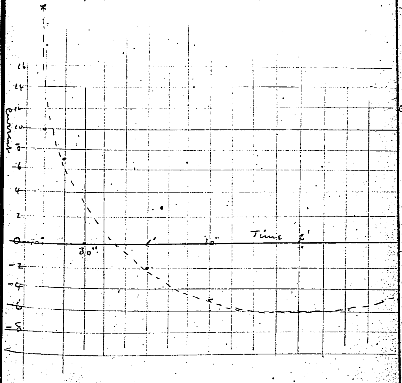
Coloration remains after discharging

182 Solution #23 - arsenic acid - Forti [Cu & Cu]

Battery	cell	Time	Deflections
	nothing	10' 11' 00	18 dir. strap
		12' 30	8 " "
		12' 00	5 " "
		21	2 " "
		3 seconds	20 on coil
		10 "	10
		20	7
		30	0 ?
		1 min	- 2
		1 & 30 sec	- 5
		2 minutes	- 6
		3 "	- 5
		4 "	- 4
		5 "	- 4
		6 "	- 4
	nothing	10 37	18 on strap
		37 30	11
		42	7
		4 seconds	22 on coil
		10 "	2
		20 "	- 7
		30 "	- 9
		40	- 9
		50	- 9
		1' 30 "	- 9
		2 minutes	- 9

Coloration before charging 183

Dark deposits on plates
No precipitate



184 Storage Batteries _ Copper strapper 29th April 85

Solution #23 – arsenic acid strong

Battery	Cell	Time	Deflection
30 433	not a primary cell.	2h 43 : 30"	28 on strap
		45"	14
		44	8
		2. 53 30	4
		3 Seconds	40 on coil
		10	25
		20	10
		30	2
		40	0
		50	0
		1 minute	0

28 Pyrogallic acid

Battery	Cell	Time	Deflection
	Resting	3h 15	6 on strap
		15 30	4
		38	
		seconds	on coil
		10	20
		20	18
		30	11
		40	9
		50	8
		1' 20	7
		2'	6
		3'	3

Repetition of former experiments 185

One plate slightly stained

Solution #29 – Tanic Acid. copper & copper

Battery	Cell	Time	Deflection
	not priming	3h 33'	5 on shap
		35	2 " "
		43	2 " "
		5 seconds	20 on coil
		10 "	9
		20 "	7
		30 "	6
		40 "	6
		50 "	5
		1 min	5
		2 "	4

#14 Ferro cyanide

Battery	Cell	Time	Deflection
20418	nothing	3h 48'	5 on shap
		49	4 "
		58	
		seconds	100 on coil
		10	15 "
		20	8
		30	5 "
		40	3 "
		1 min	3

#21 – Acetic Acid

Battery	Cell	Time	Deflection
	nothing	4h 03'	2 on shap
		13	1 " "
		3 seconds	60 on coil
		10	55
		20	51
		30	48
		40	40
		60	25
		1 min 10 "	18
		2 "	10
		3 "	7

White frothy gas accumulated
slight discoloration of plates

Rapid evolution of gas from negative plate.
Both plates darkened, especially the one from which the gas was rising.
No precipitate.

Gas from both plates.
Slight discoloration

Solution #19 – Soda acetate
on r. ctr.

Bat.	Cell	Time	Deflections
26429	nothing	4h 24'	3 on strap
		" 34'	2 " "
		6 seconds	-20
		10	-10
		20	5
		30	-3
		40	1

Solution #45 – Barium chloride

Bat.	Cell	Time	Deflections
—	—	+ Mang	"
	nothing	4h 45'	10 on strap
		45 20"	8 " "
		46	6 " "
		55	3 " "
		3 seconds	40 " coil
		10	8 " "
		20	6 " "
		30	5 " "
		40	4 " "
		1 min	4 " "
		1 " 30 seconds	3 " "
		2 "	2 " "

no coloration of plates.

gas rapidly formed
positive plate discolored slightly

negative plate darkened

Solution #37 - Lateric & Phosphoric acids — Cu & Cu

Battery cell		Time	Deflection
32 Left / 35 Right	not primary	9:54:	5 on strap
		55	6 " "
		10:05	6
		seconds	128 on coil
		10	80
		20	50
		30	30
		40	23
		50	19
		60	16
		1m 920 secs	14
		2m	10
		2m 4 ½	8
		3m	2

#44 - Barium chloride

27 left / 25 left	not primary	10h 15'	6 on strap
		25' 30"	4 " "
			3 "
		seconds	30 on coil
		10	5
		20	4
		30	3
		40	2
		50	2
		1m	1

Gas given off a little
Positive plate darkened slightly

Whitish precipitate formed
very little gas evident

Cu + Cu

Solution #40 - alum & Mg Sulphate

Bat	Cell	Time	Deflections
25 left 23 right	Nothing	10:36	5 on strap
		1 second 46	5 on "
		10 "	24 on coil
		40	12
			6
		50	1

Cu & Cu

30th Apr. 1885

Solution #34 - Oxalic Acid.

37 left 33 right	not primary	8h 25'	15 on strap
		25' 10"	7
		37	4
		6 seconds	12 on coil
		10	7
		20	5
		30	4
		40	3
		1 min	2

#35 Oxalic & Phosphoric acid

	Nothing	8:45	12 on strap
		46	9 " "
		55	6
		5 seconds	40 on coil
		10	32 " "
		20	27
		30	27
		40	20
		1 min	14
		" 30	10
		2 "	7
		3 "	3

Gas given off
Both plates blackened

Remarks

Positive plate blackened
negative plate giving off gas freely.

Both plates black after discharge
liquid turned greenish in color,

Both plates giving off gas
a faint cloudy precipitate from
positive plate - green in color,

 Solution #36 - Tartaric acid. Cu & Cu

Battery	Cell	Time	Deflection
22	not	9h 07'	.5 on strap
22	primary	08	4 .. ..
		17	3 ..
		5 seconds	30 on coil
		10	20
		20	13
		30	7
		40	4
		50	3
		1 min	2

#38 - alum Cu & Cu

22 right 22 left	nothing	9h 25'	7 on strap
		26	5 .. ..
		35	4
		6 seconds	25 .. coil
		10	15
		20	9
		30	3
		40	2
		50	1

#39 alum & Phosphoric acid

	nothing	9h 37'	9 on strap
		38	6
		47	5 ..
		3 seconds	50 on coil
		10	20
		20	6
		30	3
		40	2
		50	1

Slight amount of gas
no coloration

Positive plate blackened
Gas from negative
no coloration
Both plates darkened on discharge

same as previous test

Cu & Cu 4th May. 1885

96 Bromide of Potassium

Cell	Time	Deflection
27 927 nothing	9h 40'	10 on strap
	40' 15"	8 " "
	50'	2 " "
	5 seconds	6 on coil
	10 "	4 " "
	20	3 " "
	30	1
	40	1
	50	1 " "
	60	1
	1 m & 10"	0 " "

Potassic Carbonate — Cu & Cu

Cell	Time	Deflection
nothing	9h 55'	3 on strap
	10h 05'	2 " "
	5 seconds	4 on coil
	10 "	2 " "
	20 "	0 " "

Permanganate of Potash

Cell	Time	Deflection
nothing	10h 12' "	15 on strap
	12' 30"	10 " "
	22	
	seconds	7 on coil
	10 "	4 " "
	20 "	2 " "
	30 "	1 " "
	40 "	0 " "

97

Remarks

Gas evolved from one electrode and a white coating formed on other. no precipitate perceptable.

Coating remains after discharge

Green flaky deposit forms on one copper & is precipitated by jarring.

No action on plates.

Bicarbonate of Potash — cinder

Bat.	Cell	Time	Deflection
23 left	not a	10h 28'	3 on strap
22 right	priming	38	3 "
		3 seconds	10 on coil
		10 "	4 " "
		20 "	2 " "
		30 "	1 " "
		40 "	1 " "

Green flaky deposit & precipitated a little gas from each plate.

Sulpho-Cyanide of Potassium

	nothing	10h 43'	2 on strap
		52	0 " "
		7 seconds	7 on coil
		10	5 " "
		20	3 " "
		30	1 " "

Gas from electrode.

Sulphate of Iron

21 left	nothing	10h 55'	2 on strap
22 right		11 05'	2 " "
		5 seconds	50 on coil
		10	30 " "
		20	15
		30	10
		40	7
		50	7 1/2
		1 min	5
		1 " 30 secs	4
		2	2
		3	1

Plates stained black very little gas evolved

# 16 ~~20 8~~	Hempen Carb & Glacial acid		Cu & Cu
Battery	Cell	Time	Deflections
20 right	not a	11:24	2 on strap
19 left	primary	:34	1 " "
		5 seconds	2 on coil
		10 "	1 " "
		20 "	1
		30 "	0 "
~~#30 — Lanic & Phosphoric acids~~			
	Nothing	11:38	6 on strap
		39	5 " "
		48	
		seconds	on coil
		10 "	40 " "
		20 "	28 " "
		30 "	20 " "
		40 "	14 " "
		50 "	9 " "
		1 min "	6 " "
		1 " 30 secs	2 " "
Hypo-sulphite of soda			
20 right	Nothing	11:56	2 on strap
20 left		12:06	2 " "
		8 seconds	9
		10 "	7
		20 "	3
		30 "	3
		40 "	2
		50 "	1
		1 min	1

Remarks

Gas from one plate
other plate stained slightly

Plates stained
very little gas evolved

Dark deposit on one plate and
a precipitate from it,

~~Batt.~~ Iron & Iron

Solution #10 - Glacial Phosph. acid

Battery	Cell	Time	Deflections
19 right	with a primary battery	1:05 a.m.	13 on strap (charge)
19 left		:06 "	11 " "
		:15	9
		8 seconds	11½ " coil (discharge)
		10 "	10 " "
		20 "	9 " "
		30	8 " "
		40	6 " "
		50	5 " "
		1 min	5
		" 30 sec	4 " "
		2 "	3 " "
		3 "	3
		4 "	3

#11 Hyd. Oxyd. of Mangan & glacial phos. acid

Battery	Cell	Time	Deflections
18 right	nothing	1:22	~~3~~ 2 on strap
17 left		33	2 " "
		5 seconds	15 " coil
		10	7
		20	3
		30	1

#14 Ferric-Cyanide

Battery	Cell	Time	Deflections
14 left	nothing	3:03	7 on strap
13 right		13 : 30"	6 " "
		13	6
		5 seconds	5 on coil
		10	3
		20 "	3
		30 "	2
		40 "	2
		50 "	1

Remarks

Gas arises from both electrodes. Electrodes both turn a red-brown color.

Dark deposit on both plates - Turned liquid dark. Very little gas evolved

A little gas given off. Dark colored deposit on both plates. Solution not discolored

 #15 – Boracic acid. Fe & Fe

Bat	Cell	Time	
14 left 13 right	nothing	2:20	0 on strip
		30	0 " "
		10 seconds	1 on coil

#18 – Phosphate of Soda

	nothing	2:34	2 on strip
		:34 1/2	1 " "
		:44	
		7/10 seconds	13 on strip
		20	11

#19 Soda acetate

14 left 15 right	nothing	2:54	0 on strip
		3:04	
		7 seconds	12 on coil
		10 "	8
		20 "	6
		40	3
		1 min	2

Sulphate Zinc & Sulphate Iron

480 R.	1°	2.39 A.M.	14° on Strap
		49	
		7 seconds	20 on Coil
		16	19
		26	14
		30	12
		1 minute	9
		2	7
		3	6
		4	5
		5	4
		8	3
		12	2
		15	2

Plates nearly unchanged

Plates slightly discolored

No change in plates

May 6, 85

No gas or coloration either on charging or discharging.

Discharges in reverse direction

11 - Manganese Carb. & Glacial acid.

Fe & Fe 5th May

Battery	Cell	Time	Deflection
33 left 34 right	Nothing	2:30 P.M.	9 on strap
		:30 :30"	7 " "
		40	7 " "
		5 seconds	15 on coil
		10 "	9
		20 "	9
		30 "	6
		40 "	4
		50 "	3
			2

# 20 - acetic acid			
	Nothing	2:46'	8 on strap
		56	8 "
		8 seconds	30 " coil
		10 "	25 " "
		20 "	24
		30	23
		1 minutes	23
		2 "	23
		3 "	23
		4 "	22
		5 "	22
		6 "	22
		7 "	21
		8 "	21
		9 "	20
		10 "	20
		11 "	19
		12 "	18
		14 "	17
		16 "	16
		18 "	14
		20 "	11
		22 "	7
		24 "	3
		25 "	0

Gas given off rapidly from negative electrode.

Gas given off freely from one plate

Faint coloration of plates

Both plates give off gas equally during discharge.

Plates stained black

21 acetic, Phosp. acid placid + aq

Battery	Cell	Time	Deflection
35 left 39 right	Nothing	3h 30'	14 on strip
		30' 30"	9 " coil
		40'	6
		5 seconds	10 on coil
		10 "	8
		20 "	6
		30 "	5
		40 "	4
		50	3
		1 min	3
		1 " 30"	3
		2 "	

23 Strong arsenical acid

Battery	Cell	Time	Deflection
38 left 40 right	Nothing	3h 50'	24 on strip
		50' 30"	12 "
		4h 00	8 "
		5 seconds	50 on coil
		10 "	46
		20	41
		30	39
		40	37
		50	35
		1 min	34
		1 " & 30"	32
		2 "	30
		3 "	28
		4 "	24
		5 "	21
		6 "	18
		7 "	15
		8 "	13
		9	12
		12	10

Gas given off equally from both electrodes.

Little gas given off during discharge

Gas given off in small quantities.

Dark deposit

Very little gas given off during discharge

Fe & Fe

#29 Tannic acid

Bat.	Cell	Time	Deflection
40 right 30 left	nothing	4:27	20 on strap
		:28	18 " "
		:37	15 " "
		4 secs	40
		10 "	23
		20	13
		30	8
		40	6
		50	4
		1 min	2

#28 – Pyro-Gallic acid

	1° deflection	4:46'	20 on strap
		:47	19 " "
		:56	16 " "
		4 seconds	12 on coil
		10 "	6 " "
		20 "	3 " "
		30 "	2
		40 "	1

#25

~~30 left 31 right~~	~~nothing~~	~~5h:01'~~	~~9 on strap~~
		~~:02~~	~~7 " "~~
		~~:11~~	
		~~seconds~~	
		~~10 "~~	
		~~20~~	
		~~30~~	

Gas given off freely.
Whitish precipitate.

Very heavy precipitate, forming a thick foamy mass, pink in color.

Gas given off freely.

Purplish coloration of plates.

Gas freely evolved

 6th May. Fe & Fe

#25 – Citric acid

50 left 52 right	nothing	10:11 am.	9 on strip
		12 "	8 "
		21 "	8 "
		5 seconds	2 on coil
		10	1
		20	1
		30	0

Gas given off freely from the negative electrode.
Greenish color given to solution

#34 – Oxalic acid.

	1° defl.	10^h 31'	18 on strip
		30"	14 " "
		41	07
		4 seconds	24 on coil
		10	15
		20	9
		30	5
		40	4
		50	3
		1 min	1

Decided green color given to solution
Gas given off lightly.
Plates stained black

#30 – Lime acid & Phosp. acid Glacial

39 left 38 right	nothing	10:59	18° on strip
		59 30	17 " strip
		11:09	15 " "
		5 seconds	7 on coil
		10 "	4
		20 "	2
		30 "	1
		40 "	0

Gas given off very freely from negative electrode

#31 - Glycerine & salt (NaCl) Fe & Fe

36 left 36 right	nothing	11:25 :35 5 seconds 10	1/2 on strip 1 on coil 0

#32 - Glycerine & H_2SO_4

44 right 40 left	1/2°	11:53 :54 12:03 5 seconds 10 20 30 40	29 on strip 14 " " 13 " " 1 on coil 1 1 1 0

#35 - Oxalic & Phosph. acid

37 left 37 right	nothing	12:10 Pm :10:30 20 5 seconds 10 20 50	22 on strip 19 " " 11 2 on coil 4 1 0

#33 - Glycerine & Phosp. acid Glae.

	nothing	12:29 :39 3 seconds 10 20 30	3 on strip 2 " " 6 on coil 2 1 1

No chemical action at first. 15

Gas given off lightly from the negative plate

No staining.

Gas from negative electrode given off very rapidly. From positive fairly.

Gas given off rapidly from - and faint green precip. from +

Very little stain

Gas evolved.

No deposit.

 #36 - Tartaric acid : [illegible]

36 left 38 right	nothing	12:45 P.m	11 on strip
		:46	9 " "
		:55	9 " "
		5 seconds	3 on card
		10	2
		20	1

#37 - Tartar. acid + Phosp. acid

	nothing	1: 03	20 on strip
		:04	17 " "
		:13	14 " "
		5 seconds	7 on card
		10	5
		20	4
		30	4
		40	3
		1 min	2

#38 - alum

32 left 34 right	4° defl.	1h: 21	14 on st.
		:22	13 " "
		31	13 " "
		5 secs	12
		10	05
		20	0
		30	2
		40	4

Positive plate darkened
negative " gives off gas freely.

Gas given off as before

Dark coloration on both plates

Gas given off freely from negative pl.
Negative pl. blackened
Positive yellowish coating.

#39 – Alum & Phosp. acid

30° left	1° defl	1h 36'	19° Str.
32		30	18° "
		46	15
		4 seconds	11 coil
		10	8
		20	7
		30	6

#40 – alum & Mangan. sulp.

	nothing?	1h 50	13 Str.
		51	11
		2h 00	10
		5 seconds	18 coil
		10	8
		20	2
		30	1
		40	1

#44 – Ba Cl2

28 left	1°	2h 04	14 Str.
28 right		05	13
		14	12 "
		5 seconds	38 coil
		10	20
		20	14
		30	10
		40	7
		50	5
		1 min	4
		1 " ~~30~~	4
		" " 30	3
		2 min	2

Gas given freely
Plates not darkened much

Gas given off as before
Reddish deposit on positive pl.

Positive pl. discolored
Negative gave no gas
Green cloudy deposit, or precipitate heavy
Frothy mass at surface

#45 $BaCl_2 + MnCl_2$

26 left 27 right	2° defl	2h 24'	15 steady
		25	13
		34'	13
		4 seconds	16 cont
		10	8
		20	6
		30	4
		40	3
		50	2

Gas evolved freely
Yellowish brown pp.
Plates blackened.

#50 Carb. of Potass.

34 left 34 right	1°	3h 34'	6 steady
		44	5
		5 seconds	9 cont
		10	7
		20	6
		30	5
		40	4
		50	3
		1 min	2

Gas evolved.
Heavy white flaky pp.

#51 Bi-carb of Potass.

	1°	3h 48'	8 steady
		49	8
		58	8 "
		3 seconds	10 cont
		10	12
		20	9
		30	7
		40	5
		50	4
		1 min	3

Gas from negative plate
and from positive freely
White flaky pp. immediately formed
falling from plate.
Solution turned greenish

#52 – K_2SO_4 (Sulph of Potass)

29 right 29 left	nothing	4° 01	12 on strip
		02	10 " "
		11	20 " "
		3 seconds	20 on coil
		10 "	12
		20 "	7
		30 "	5
		40 "	4

#53 Bisulph of Potass.

	1°	4h 15	18 on strip
		16	15 "
		25	13 " "
		3 seconds	9 on coil
		10	7 " "
		20	7 " "
		30	6 " "
		40	6 "
		1 min	6 "
		2 "	5 " "

#54 – Bromide of Potass.

25 left 24 right	nothing	4 38	12 on st
		39	10 "
		38	10
		5 seconds	19 coil
		10	11
		20	6
		30	4
		40	2
		50	1

Gas given off
Whitish deposit of P.
Precipitated in a stream 3/4 inch from bottom of [illegible]

Gas given off
no deposits

Gas given off
Plates darkened

#55 – Permanganate of Potash

25 left 26 right	Nothing	4 : 42	04	on str
		: 43	03	
		; 52	03	
		4 seconds	17	on coil
		10 "	10	
		20	7	
		30	5	
		40	4	
		50	3	
		1 min	3	

#56 Sulpho-Cyanide of Potass.

Nothing	5:01	10	on str
	:02	9	
	:10	9	
	3 seconds	35	on coil
	10	21	
	20	14	
	30	8	
	40	5	
	50	4	
	1 min	3	
	1 " 10	3	
	1 " 20	2	

very little chemical action

Gas given off freely

Black p.p. formed

 Storage Batteries — Fe & Zn 7th May 85

#58 — Hypo-sulphite of Potass

Battery	Acid	Time	Defl.
44 left	Nothing	9:14	26 on strip
45 right		15	24 " "
		24	16 " "
		5 seconds	70 on coil
		10	50
		20	27
		30	18
		40	13
		50	11
		1 min	10
		1 " 10 secs	9
		1 " 20 "	9
		1 " 30 "	8
		1 " 40 "	8
		2 "	7

#57 — Ferro-cyanide of Potass.

Battery	Acid	Time	Defl.
30 left	Nothing	9:37	9 on strip
32 right		:38	7 " "
		:44	6 " "
		4 seconds	70 on coil
		10	40
		20	24
		30	16
		40	10
		50	7
		1 min	6
		1 " 10 secs	6
		20	5
		30	5
		40	5
		50	4
		2 min	4
		10	4
		20	3

Remarks

Dense, black, cloudy precipitate immediately formed. Does not adhere to electrodes.

Very little pp formed.

Nothing black [illegible] [illegible] Positive [illegible] [illegible].

No precipitate immediately first

cloudy pp formed later.

228 #3 — Red fluid   Fe & Fe

31 left   2° defl
33 right

17' 30" -36
18' 40" -35
--- -34
10" -- 32
30" -- 30
50" -- 28
19' --- 27
20" -- 26
40" -- 24
20' --- 21
20" -- 18
40" -- 16
21' --- 14
20" -- 13
40" -- 12
22' --- 10
20" -- 9
40" -- 8
23' --- 7
20" -- 7
40" -- 4
24' --- 3

9h 5.4 am. — -26 on strip
5.5 — -8 " "
10h 0.4 — -6 " "
6 seconds — +7 on coil
10 " — +4 "
20 — +2
30 — 0
40 — -2
50 — -4
1 min — -5
" " 10 sec — -6
1 " 30 " — -7
1 " 50 " — -8
2 " 10 " — -9
2 " 30 " — -11
2 " 40 " — -12
2 " 50 " — -13
3 " — -16
3 " 20 " — -19
3 " 30 " — -22
3 " 40 " — -25
3 " 50 " — -31
4 — -42
4 " 10 " — -70
4 " 20 — -90
4 " 30 — -80
4 — 50 — -70
5 — -60
5 — 20" — -55
5 — 30" — -55
5 — 50" — -54
6 — 10 — -53
30 — -50
50 — -48

229

Gas formed at both plates
Negative plate has black deposit

Solution becomes very hot.
On testing a new solution & fresh plates
a deflection of 45 was obtained

11' 50" -48
12' --- -48
20 -47
40 -46
13' --- -46
40 -48
14' --- -47
20 -51
30 -44
40 -44
50 -43
15' --- 46
10 50
20 53
30 49
40 48
50 45
16' --- 44
20" 42
50 41
17' --- 42
20" 38

7 min --- -47
20" -46
30" -44
40" -43
8 — 50 -42
--- -41
10 -42
20 -44
30 -45
9 — 50 -46
--- -47
10 -47
20 -48
30 -50
40 -48
10 --- -50
20 -48
30 -46
40 -49
50 -52
11 --- -54
10 -10 -51
30 -51

#6 - Manganese sulphate   Fe 8 '21

35 left 38 right	Nothing	10:46 ---	13 on strip
		:47 ---	13 "
		:56 ---	9 "
		4 seconds ---	72 " coil
		10 ---	60
		20 ---	48
		30 ---	36
		40 ---	30
		50 ---	24
		1 min ---	18
		10 ---	15
		20 ---	12
		30 ---	8
		40 ---	6
		50 ---	4
		2 min ---	3
		10 ---	3

#7 Manganese Chloride

34 left 34 right	1° defl	11h 39' ---	19 on strip
		40 ---	15 "
		49 ---	10
		secs	80 on coil
		10 ---	70
		20 ---	60
		30 ---	55
		40 ---	48
		50 ---	38
		1 m ---	26
		10 ---	18
		20 ---	14
		30 ---	12
		40 ---	10
		50 ---	9
		2 m ---	8
		10 ---	7
		20 ---	7

Gas given off rapidly
Positive plate turned rusty color.

Red cloudy p.p. formed
Part rises to surface

Very little gas given off
Yellow gelatinous substance rises to surface

#8 – Phosphoric acid Fe + Zn

33 left 35 right	Nothing	12^h 55'	16 on strap
		55 30	14 " "
		1^h 05 P.M.	10 " "
		0^min 3 seconds	8
		10	6
		20	5
		30	4
		40	4

#9 – MnSO4 + ZnSO4

	Nothing	1^h 10	15 on strap
		11	14 " "
		20'	11 " "
		0^min 3 secs	55 " "
		10	30 on coil
		20	20 " "
		30	16 " "
		40	14 " "
		50	13 " "
		1^m	13 " "
		10	12 " "
		20	12 " "
		30	11 " "
		40	11 " "
		50	11
		2'	10 " "
		10	10 " "
		20	10
		30	10
		40	10
		50	9
		3	9
		10	~~8~~ 9
		20	9
		30	8

Gas evolved
Plates blackened
No coloration of fluid.

Very little gas given off
Negative plate unaffected
Positive " blackened
Slight blackening of P.

 Carbon & Carbon

plates 1/8 inch apart instead of 1/4 inch, as in previous metals

#3 - Red Fluid ($K_2CrO_4 + H_2SO_4 + aq.$)

Battery	Cell	Time	Defl.
31 right	Nothing	1h 58 P.M.	17 on strap
31 left		59 "	14 (strap)
		2h 08 "	10 " "
		0 min 3 secs	2 on coil
		10	1 (discharge)
		20	1
		30	1
		40	1

#6 Manganese Sulphate

Battery	Cell	Time	Defl.
26 right	1° defl (coil)	2h 14	5 on coil
26 left		14 1/2	3 "
		24	2
		0 min 6 secs	70 on coil
		10	65
		20	46
		30	36
		40	29
		50	26
		1m	21
		10	19
		20	17
		30	15
		40	13
		50	11
		2m	10
		10	9
		20	8
		30	7
		40	7
		50	6

Remarks

Fluid darkened in color
no visible change in [illegible].

Gas rises from [illegible]

#7 Manganese chloride C + C

29 right Nothing 2^h 29' — 6 strip
29 left 30 — 5 "
39 — 3

0 min	5 seconds	on coil
	10	80
	20	60
	30	45
	40	34
	50	27
1 min		22
	10	18
	20	13
	30	13
	40	12
	50	11
2 min		10
	10	9
	20	8
	30	8
	40	7
	50	7

#8 – Phosphoric acid

2^0 (coil) 2^h

	49'	7 on strip
	50	4 "
	59	3 " "
	0 seconds	12 on coil
	10	8
	20	5
	30	4
	40	3
	50	2
1 min		2
	10	1
	20	1

Gas from negative.
little from positive

Gas from both carbons

 1/9 $MnSO_4 + ZnSO_4$ C&L

20 left 30 right	nothing	3^h 3' PM	5	sec
		13	3	
		secs		cont'd
		10	110	
		20	80	
		30	65	
		40	55	
		50	47	
		1 min	39	
		10	35	
		20	31	
		30	28	
		40	25	
		50	23	
		2 min	21	
		10	20	
		20	19	
		30	18	
		40	17	
		50	16	
		3 min	15	
		10	14	
		20	13	
		30	12	
		40	11	
		50	11	
		4 m	10	
		10	10	
		20	10	
		30	9	
		40	9	
		50	9	
		5 m	9	

Gas only given off from one plate
No chemical action visible

240 #10 Glacial Phos. acid C & C

29 left 29 right	1° defl	3^h 25'	6 strip
		35'	6 "
		5 secs	50
		10	44
		20	30
		30	26
		40	22
		50	20
		1 min	19
		10	18
		20	18
		2 m	15

Gas given off from intra points

#11 Hypers. Oxyd. Mangan & Glac. Phos acid

30 left 31 right	Nothing	5^h 12'	10 on strip
		13'	5 "
		22'	6
		6 secs	40 on coil
		10	23
		20	13
		30	10
		40	7
		50	5
		1 min	4
		10	3
		20	3
		30	2
		40	2

a little gas given off

apparently a black dl point on negative Carbon after discharge

19 – Soda acetate

C & L

31 left 30 right	nothing	5.h 34' ---	5 on strip
		35 ---	4 " "
		44 ---	3 "
		3 secs	30 on coil
		10 ---	18 on coil
		20 ---	9 " "
		30 ---	6 " "
		40 ---	4
		50 ---	4
		1 min ---	3
		10 ---	3
		20 ---	3
		30 ---	2
		40 ---	2

Brown coloration [illegible] to [illegible]

[illegible] little [illegible]

8th May. 1885 CPL

#18 Solution — Phosphate of Soda

Battery	Cell	Time	Deflections
38 right 36 left	nothing	9h 11' am	6 on strap
		12	4 " "
		21	3 " "
		5 secs	30 on coil
		10	21
		20	8
		30	5
		40	3
		50	3

— Gas from both plates but in excess from negative.

#20 — Acetic Acid

Battery	Cell	Time	Deflections
35 left 36 right	2° defl.	9h 34'	3 on strap
		44	3 " "
		5 secs	45 on coil
		10	27 " "
		20	18 " "
		30	13 " "
		40	10
		50	8
		1 min	7

No gas given off at any moment. a little carbon ... negative pole

#21 — Acetic + Phosph. acid Sol.

Battery	Cell	Time	Deflections
	nothing	9h 50'	6 on strap
		10h 00	4 " "
		5 secs	31
		10	22
		20	15
		30	12
		40	10
		50	9
		1 min	8
		10	7
		20	6
		30	5
		40	4

Gas given off freely from both electrodes.

 #14 - Ferric-cyanide C & C

32 left 35 right	Nothing	10° 9' ---- 5 on strip 19' ---- 3 " 5 secs 3.0 on card 10 --- 19 20 --- 14 " 30 --- 10 40 --- 7 50 --- 6 1 min --- 5	Gas given off slightly

#16 - Manganese Carb & Glacial Acid

	Nothing	10:25 ---- 3 on strip 35 ---- 1 " 5 secs -- 20 " card 10 --- 11 " 20 --- 7 " 30 --- 5 " 40 --- 4 " 50 --- 3 "	No visible chemical action

#15 - Boracic acid

30 left 33 right		10:39 ---- 1 on strip 49 --- 0 " " 3 secs - 18 on card 10 " - 5 20 " - 4 30 " - 3 40 -- 2 50 -- 2 1 min --- 1 10 --- 1	No gas given off

 C & C

#23 - Arsenious acid

31 left
33 right

Nothing 10h 45' ------ 1° on strip
50 ---- 0° " "
4 secs -- 12 on coil
10 --- 9 " "
20 --- 7 " "
30 --- 6 " "
40 --- 5 " "

#24 - $ZnSO_4 + H_2SO_4$

Nothing 11h 02' ------ 10 on strip
12 ---- 4 " "
35 secs - 150 on coil
10 --- 80 " "
20 --- 50
30 --- 35
40 --- 29
50 --- 23
1 min ---- 19
10 --- 17
20 --- 16
30 --- 15
40 --- 14
50 --- 13
2 m ------ 12
3 m ------ 9

#25 - Citric acid

30 left
31 right

1° defl 11h 22 --- 3 on strip
32 --- 1 " "
6 secs - 15 on coil
10 --- 11
20 --- 7
30 --- 5
40 --- 4
50 --- 3
1 min ----- 3

Small quantity of gas [illegible]

Small quantity of gas [illegible]

Gas accumulated on negative pole

 C & C

#28 - Pyro-gallic acid.

31 left 33 right	Nothing	12^h	01 ---- 2 on step 11 ---- 1½ " " 5 secs - 15 on cont. 10 --- 9 20 --- 6 30 --- 4 40 --- 3 50 --- 3	Fluid opaque Plates not stained

#29 - Tannic acid

	Nothing	12^h	17' --- 1 on step 27 --- 0 " " 4 secs 11 on cont 10 -- 8 20 -- 6 30 -- 4 40 -- 3 50 -- 2	a little gas over curr.

#30 - Tannic acid + Phos. Acid Sol.

31 left 33 right	Nothing	12^h	36 P.M. 6 on step 46 " -- 3 " " 5 seconds - 64 10 --- 47 20 --- 27 30 --- 14 40 --- 7 50 --- 6 1 min --- 5 10 --- 5 20 --- 4 30 --- 4 40 --- 4 50 --- 4	Gas given off freely from negative electrode, Whitish deposit on + [illegible]

C & E

#31 Glycerine & Common Salt.

	Nothing	12h 51 P.M.	½ defl. strap	No action –
		1 01 ..	0 " "	
		6 secs –	4 on coil	Very small quantity ...
		10 – –	3	
		20 – –	3	
		30 – –	2	

#32 Glyc. & Sulph. acid

31 left	3° defl.	1h 7' – –	5 on strap	Gas from both ... from
33 right		17' – –	3	negative.
		5 secs –	10 on coil	
		10 – –	5	
		20 – –	3	
		30 – –	2	
		40 – –	2	

#33 Glyc. & Phosph. acid Glac.

	Nothing	1h 35' – –	2 on strap	Gas from neg ...
		45 – –	1 " "	
		4 secs	7 on coil	
		10 – –	4	
		20 – –	3	
		30 – –	2	

#34 – Oxalic acid

30 left	Nothing	1h 48' – –	8 on strap	Gas from both ... from
31 right		58 – –	5	negative plate
		6 secs –	13 on coil	No precipitate
		10 – –	7	Green coloration around ...
		20 – –	4	
		30 – –	2	
		40 – –	2	
		50 – –	1	

e r e

#35 – Oxalic acid + Phosph. acid

25 left 26 right	1° defl	2°	2'	5 on strip
			12	4 " "
			5 secs	40
			10	30 on coil
			20	18
			30	13
			40	11
			50	9
			1 min 6	7
			10	6

Gas from both cells

#36 – Nitric acid

	Nothing	2°	17'	2 on strip
			27	2 " "
			6 secs	35 on coil
			10	26
			20	19
			30	14
			40	12
			50	10
			1 min	8
			30	5

Gas in small quant. [illegible] negative plate

#37 Nitric & Glac. Ph. acid

	Nothing	2°	30'	4 on strip
			40	3 "
			5 secs	70 on coil
			10	55
			20	34
			30	24
			40	16
			50	12
			1 min	10
			10	9
			20	8
			30	8
			40	7

Gas from both, [illegible] from neg. plate

 #38 – alum. C&C

27 left not a	2h	44'	4 on strip
29 upper. primary		54	3 "
		5 secs	60 on coil
		10	26
		20	14 "
		30	10
		40	8
		50	7
		1 min	6
		10	5

#39 – alum & Phosph acid

1° defl	3h	01'	3 on strip
		11	3 " "
		5 secs	33 on coil
		10	24
		20	17 "
		30	15
		40	13
		50	12
		1 min	11
		2 "	7

#40 alum & Mang Sulph.

nothing	3h	24'	7 on strip
		34	3 " "
		6 secs	60 on coil
		10	50 " "
		20	38 "
		30	31 " "
		40	27
		50	23
		1 min	20
		10	18
		30	12
		2 min	8
		3	5

little gas given off.
no coloration.

Gas given off from [illegible]
[illegible]

Gas freely liberated [illegible] platinum plate

44 Barium Chloride (Bach) C + C

25 left 27 right	nothing	3h 39'	3 on strip
		49	1
		5 secs	50 on coil
		10	28
		20	16
		30	11
		40	8
		50	6
		1 min	5

45 – Barium chl + Mang. Chl.

	1 deg. defl	3h 54'	8 on strip
		4h 04'	4
		7 secs	150 on coil
		10	130
		20	70
		30	40
		40	32
		50	26
		1 min	21
		10	20
		20	19
		30	15
		2 m	12
		30	8
		3 m	6
		30	5
		4 m	5
		30	4

cloudy ppt formed on negative plate. no gas given off.

very little gas given off. Rusty deposit on plates.

C & C.

#46 – Sulphate of Iron

26 left 27 right	Nothing	4v	11' --- 3 on strip
			21' --- 2 " "
			7 secs – 72 on coil
			10 --- 64
			20 --- 49
			30 --- 40
			40 --- 32
			50 --- 26
		1 min	--- 22
			10 --- 19
			20 --- 17
			30 --- 15
			40 --- 14
			50 --- 13
		2m	--- 12
			10 --- 11½
			20 --- 11
			30 --- 10
			40 --- 10
			50 --- 9
		3m	--- 9

#51 – Bicarb. of Potass.

31 left 32 right	Nothing	4v	43' --- 3 on strip
			53 --- 3 " "
			5 secs – 20 on coil
			10 --- 12
			20 --- 6
			30 --- 5
			40 --- 4
			50 --- 4
		1 min	--- 3
			10 --- 3
			20 --- 2

Very little gas given off
No deposit

[illegible] given off.

#52 — Sulphate of Potass

33 left
36 right

1° defl	4th	5-4'	44 on strap
	5th	07'	3 " "
		5 secs	41 on coil
		10	25
		20	15
		30	11
		40	8
		50	7
		1 min	6
		10	6
		20	5

#53 — Bisulphate of Potass

1° defl.	5th	14'	11 on strap
		24'	8 " "
		5 secs	35 on coil
		10 "	21
		20 "	13
		30 "	8
		40 "	6
		50 "	4
		1 min	3
		10	3
		20	3

Gas from both plates — freer from positive plate

Rusty deposit on acid plates

Gas from neg [illegible]

Action freed in solution

 #54 – Bromide of Potass. 9th May EL

55 right 55 left	Nothing	9h	02'	13 on strip
			03'	11 "
			12	9 "
			6 secs	130 on coil
			10	75 "
			20	37 "
			30	24 "
			40	16 "
			50	12 "
			1 m	10 "
			10	8 "
			30	5 "

Gas given off freely from negative plate.
seen deposit on [illegible]

#55 – Permanganate of Potass.

51 left 55 right	2° defl	9h	16'	7 on strip
			26'	4 "
			5 secs	55 on coil
			10	36
			20	24
			30	17
			40	14
			50	12
			1 m	10
			30	7

Very little gas [illegible]

#56 – Sulpho-Cyanide of K

	Nothing	9h	35'	12 on strip
			45	10 "
			5 secs	50 on coil
			10	33 "
			20	18 "
			30	13 "
			40	9 "
			50	7 "
			1 m	6 "
			10	5 "
			30	4 "

Gas freely given off at negative electr.

#57 — Ferro-cyanide of Potass.

53 left	Nothing	9h 55'	20 on chip
55 right		56	11 "
		10h 05	8 "
		5 secs	70 on coil
		10	41 "
		20	28 "
		30	22 "
		40	18 "
		50	15 "
		1 min	13
		10	11 "
		20	10 "
		30	9
		40	8 "
		2 min	7

Gas given off very freely from the platinum plate

Greenish deposit on positive plate.

#58 — Hypo-sulphite of Potass.

48 left	1° defl.	10h 10	15 on chip
52 right		11	14 "
		20	13 "
		5 secs	55 on coil
		10	28 "
		20	19
		30	15
		40	12
		50	10
		1 min	9
		10	8
		30	7
		2 m	5

Gas given off slightly.

Solution #2 - Red Fluid -

Battery	Cell	Time	Deflections
49 left	1° defl. left	10h 50' am.	4 on st. left
53 right		11h 00	3 " "
		6 secs	66 on coil right
		10	50 " "
		20	20 " "
		30	0 "
		40	12 " left
		50	14 " "
		1 min	15 " "
		10	15 " "
		30	15 " "
		2 m	16 "

#3 - Hypo-sulphite of Soda.

Battery	Cell	Time	Deflections
45 left	Zero	11h 06'	10 on str. left
49 right	Bluing	07	15 " "
		16	" "
		6 secs	7 on coil right
		10	3 "
		20	2 "
		30	1 "
		40	1 "
		50	1

Plates slightly stained
No gas given off

Black cloud immediately formed around middle & upper parts of plates
Faint white cloud around lower
page 77 - Solution fresh - saturated.
Gas from negative electrode.

#6 - Manganese Sulphate.

46 left 49 right	Nothing	11h 21'	16 on strip
		22'	15 " "
		31'	12 " "
		7 secs	5 on coil
		10	4
		20	2
		30	1
		40	1

#7 - Manganese Chloride

	Nothing	11h 34'	23 on strip
		35	22 " "
		36	21 " "
		44	16
		8 secs	90 on coil
		10	50
		20	15
		30	6
		40	3
		50	1

#8 - Phosp. acid Glacial

36 left 40 right	5 right	11h 48	3 on strip
		50	1 " "
		5 secs	15 on coil
		10	5
		20	3
		30	3
		40	3
		50	2

Gas given off very rapidly from negative plate which becomes stained black. Coating falls off partially

Gas given off very rapidly from negative plate
Plate blackened.
White cloudy at bottom.

White cloudy p.p. extends to top

Positive plate darkened
Negative " gives off gas.

#9 – $MnSO_4 + ZnSO_4$ Sn & Zn

45 left
52 right

Nothing

12:10 P.M. – 230 on strip left
:11 ---- 20 " "
21 ---- 18 " "
5 secs 160 on each right
10 – 160 " "
20 --- 150
30 – 148 " "
40 – 140 " "
50 – 185 "
1 min – 125 "
20 – 115 "
30 --- 110
50 --- 105
2 m – 100
30 --- 100
3 m --- 100
30 --- 100
4 m ---- 97
30 --- 96
5 m ---- 80
30 --- 75
6 m ---- 70
30 --- 65
7 m ---- 60
30 ---- 55
8 m ---- 50
30 – 50
9 m ---- 49
30 --- 48
10 m ---- 46
11 m ---- 45
12 ---- 44
13 ---- 44
14 minutes -- 43
15 ---- 42
16 ---- 40
18 ---- 37
20 ---- 37
22 (12:43) – 37
24 ---- 36
25 ---- 30
26 ---- 26
27 ---- 18
28 --- 15

Small quantity of gas set free at negative pole.
Plates darkened.
Negative plate blackened on discharging
Deposit on lower half of positive pl.
" very soft or spongy

Thursday 11th May

#10 – Glacial Phosp. acid Sn & Sn

Battery	Cell	Time	Defl^s
48 left	1° left	9h 14' A.M.	31° defl. left
50 right		20' ----	30 on strip
		24 ----	25
		7 secs	26 on cell
		10 ----	24
		20 ----	23
		30 ----	20
		40 ----	18
		50 ----	17
		1 min ----	15
		10 ----	14
		20 ----	13
		30 ----	12
		2 min ----	10
		3 m ----	8
		4 min ----	6

#11 – Hyper. ox. Mangan. & Phosp. Acid El.

Battery	Cell	Time	Defl^s
	nothing	9h 40' ----	4 on strip
		50' ----	1 " "
		3 secs	3 on cell
		10 ----	2 "
		20 ----	2
		30 ----	2
		40 ----	2
		50 ----	2
		1 min ----	2
		10 ----	2
		20 ----	2

Positive pole blackened.
negative gives off hydrogen rapidly

negative plate blackened [illegible] [illegible]
turns white except [illegible] of the
positive plate.

Then gas given off.
Plates [illegible] a greenish color.

Cu & Zn

#14 – Ferric Cyanide

42 left 46 right	Nothing	10^h 2'	3 on strip
		12	3 in " "
		4 secs	11 on coil
		10	9 " "
		20	8 " "
		30	8 " "
		40	8 " "
		50	8 " "
		1 min	8 " "
		30	7 " "
		2 m	6
		3 m	5 " "

#15 – Boracic acid.

	Nothing	10^h 17'	20 on strip
		15'	22 " "
		27	29 " "
		5 secs	1 on coil
		10	1 " "
		20	1 " "
		30	0 " "

#16 – Uranium sulph & Glac. acid

	Nothing	10^h 37'	3 on strip
		47	1 " "
		5 secs	5 on coil
		10 "	3 " "
		20 "	2
		30 "	1½
		40 "	1
		50 "	1

Gas from negative plate
Both plates changing in colour
at first.

Gas given off freely from neg. pl.
White cloud from positive pl.

Very little gas given off

#15 – Phosphate of Soda

43 left 40 right	Nothing	10h 49'	1 on strip
		50	0 " "
		59	" "
		3 secs	6 on coil
		10	
		20	3
		30	1 " "
		40	1 " "

#19 – [illegible]

	1° right	11h 01'	5 on strip
		30"	11 " "
		02'	12 " "
		07'	17 " "
		11 5 secs	1
		10	1
		20	1
		30	1

#20. – Acetic acid

	Nothing	11h 43'	10 on strip
		44	0 "
		53	
		4 secs	35 on coil
		10	34
		20	30
		40	28
		50	23
		1 m	10
		10	16
		30	13
		2 m	8
		30	5

very little gas given off

Gas given off freely.

Gas given off [illegible] from neg. pl.

282

S 12000

10 mg gold
150 mg silver

80

.150
.25
750
300
3.750

25
10
250.

Menlo Park Notebook #51 [N-80-03-29]

This notebook covers the period March-September 1880. Most of the entries are by Charles Batchelor. There are also entries by Edison and John Ott. Most of the material relates to the development of the carbon filament lamp. Included are notes, calculations, and drawings of machines for cutting and moulding the filaments, for making clamps, and for rolling connection wires; notes, calculations, and drawings of filament designs and vacuum experiments; and lists of carbonized materials. There are also notes, calculations, and drawings of the electric railroad; a draft letter from Edison to Babcock and Wilcox concerning steam boilers; a draft letter from Batchelor to Franklin H. Badger concerning telephone central exchange systems; and a short list of publications. The label on the front cover was originally marked "LAMPS Beginning Mch 29th 1880." Later a "C" was added to make it "CLAMPS." The book contains 283 numbered pages.

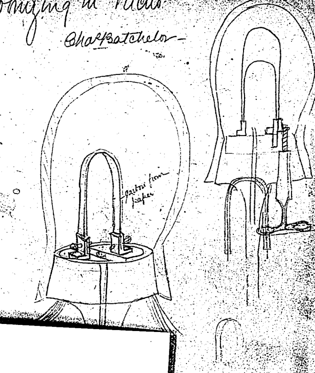
Blank pages not filmed: 128-129, 192-193, 250-263, 266-267.

Missing page numbers: 157-158, 279-282.

657 **Index.**

Carbonizing in Vacuo

Chas Batchelor



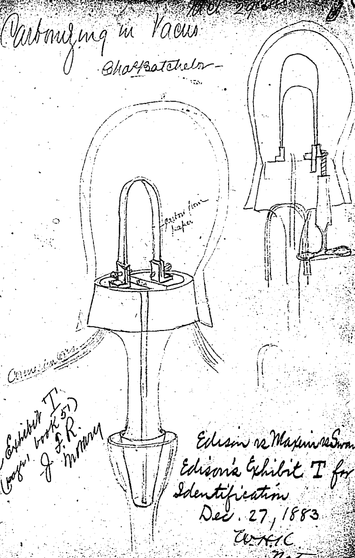
[illegible]dison vs Maxim vs Swan

[illegible]on's Exhibit T for
[illegible]tification
Dec. 27, 1883

657 Index.

Carbonizing in Vacuo

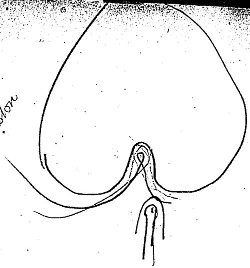
Chas Batchelor

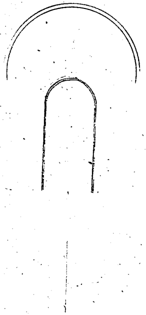


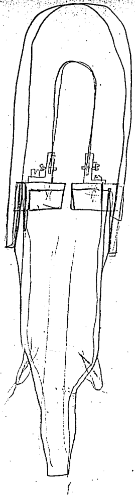
Edison Exhibit T (Orig'l book 51) J. F. R. McMenny

Edison vs Maxim vs Swan
Edison's Exhibit T for Identification
Dec. 27, 1883
W. H. C.
Notary

Dennison







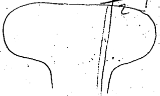
$$C = \frac{E}{R} = \frac{6E}{6R+R} = \frac{6E}{6R+12} = 3$$

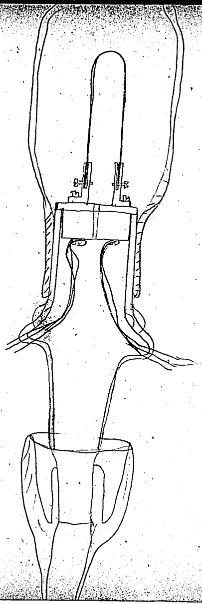
$$\frac{6E}{6\times 3+12} = \frac{6E}{30}$$

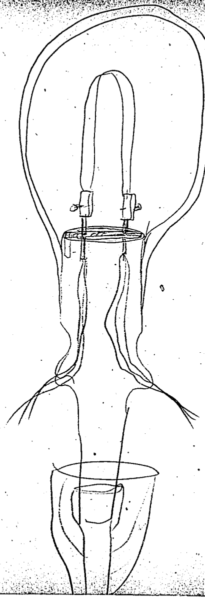
$$C = \frac{3E}{3R+3} = \frac{3E}{3\times 1.5+3} = \frac{3E}{7\frac{1}{2}}$$

$$C = \frac{3E}{\frac{3R}{2}+12} = \frac{3E}{\frac{9}{2}+12} = \frac{6E}{33}$$

$$\frac{3E}{\frac{9}{2}+2} = \frac{6E}{13}$$





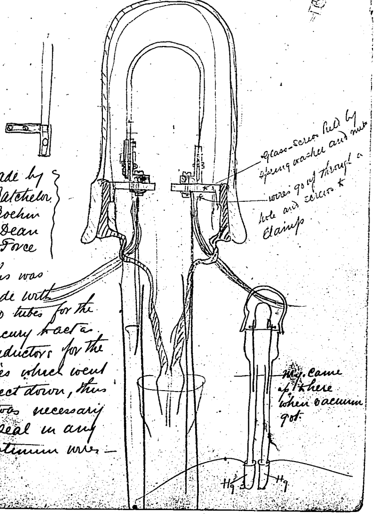


175
156
19

163
156
7

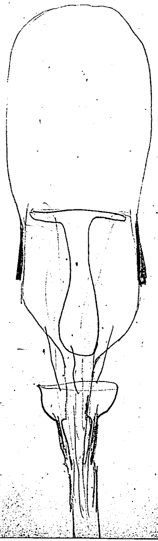
Carbonizing in Vacuum

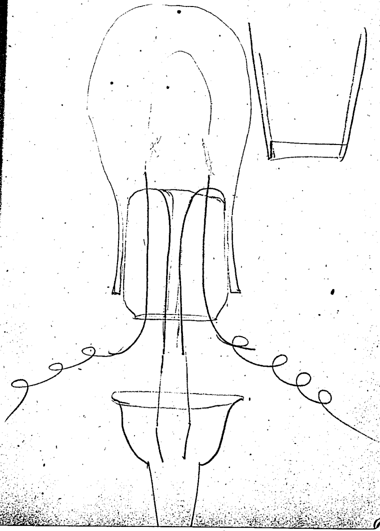
Mch 29 1881
Chas Batchelor



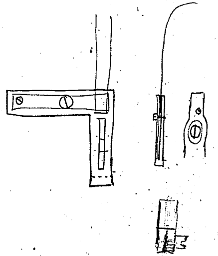
Made by
Batchelor
L. Boehm
C Dean
M Force

This was made with two tubes for the mercury to act as conductors for the wires which went direct down, thus it was necessary to seal in any platinum wires —



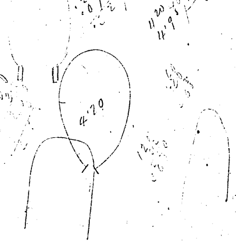


Carbonizing in Vacuum



3.03 × .03

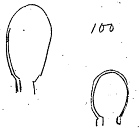
.021



4.20

Surface before surface .1260

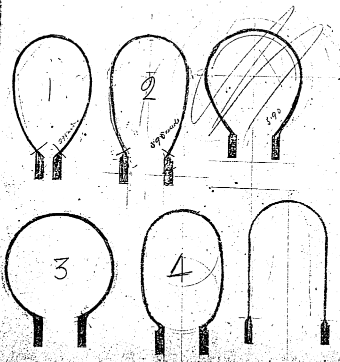
Surface after .0880



100

Apl 1st 1880

Chas Batchelor



20

.02 x .01 x 4

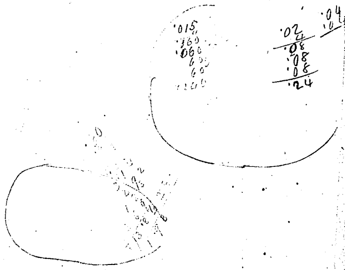
.01
4
.04
.02
.0008

.01
.02
.0002
4
.0008

.015
.300
.060
600
600
1200

.02
4
.08
.08
.08
.24

.04
.01



New Mould for paper loops

Apl 1st 1880
Chas Batchelor

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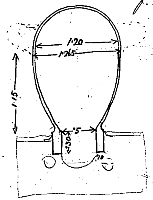
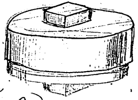
J. Bradley Made this one April 6th

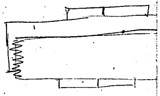


Apl 2nd 1880

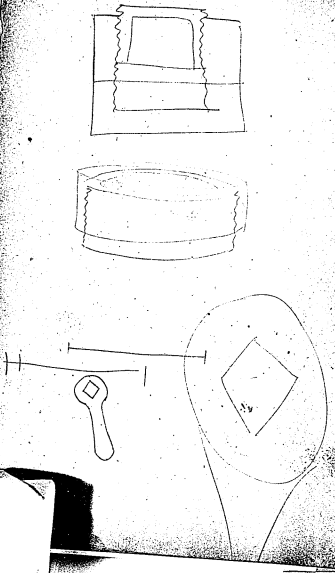
Chas Batchelor

Mould for Carbonizing under pressure

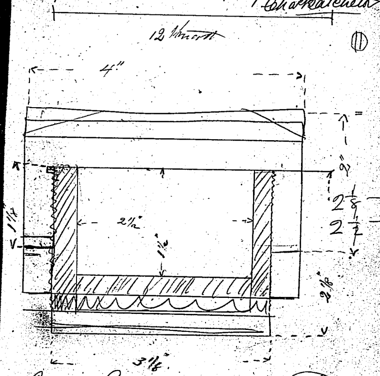




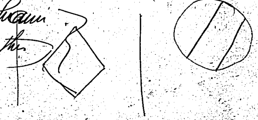
Batchelor
Kruesi and
Cunningham
Made this
B.



Mould for Carbonizing under pressure Apl 2 1880 Chas Batchelor



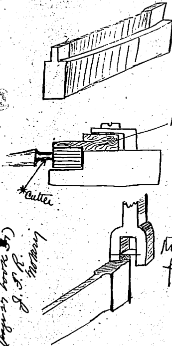
Cunningham Made this



Lamps made from Wood loops

April 6th 1880

Chas Batchelor

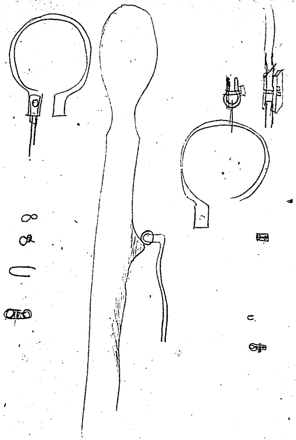


Made by
C Dean
J. Ott
C Flammer
Wm Holzer
Batchelor
Andrews
Force

The piece of so got out to be 4 X .02 X .02 and bent into shape by steaming or heating process

Edison's Exhibit (page 27 book 2) J. F. R. Notary

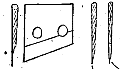
Edison vs Maxim vs Swan
Edison's Exhibit V for identification
Dec 27, 1883 WHL Notary

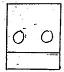


Knife for Shearing Corks from wood

Apl 6th 1880

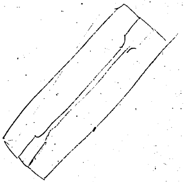
Chas Batchelor





Three Knives same shape as this ground like the above

C Dean made these



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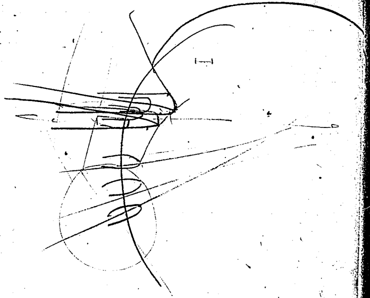
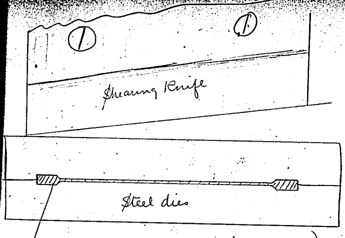




Wood in between Steel dies to be fed out just the right distance and sheared off by the Knife above as in veneering —

Woods that we cut for this process of making loops from wood :— Apl. 7th 1880

Chas Batchelor
M. N. Force

1 White Holly X
2 Willow X
3 White Thorn X
4 Bass wood X
X 5 Apple X
~~6 Maple~~ X
7 French poplar X
8 German pine X
9 Tulip X
10 Beech X
11 Pear
12 Gum X
13 White Birch X
14 Cherry X
15 White Oak
16 Black Oak
17 Ebony X
18 Pin Oak
X 19 Boxwood
20 Camphor wood
21 Satin wood X
22 Ash X
23 Hickory
24 Crapwood
25 Rosewood
26 Dogwood X
27 Black Thorn
28 Red Cedar X
29 White wood X
30 Spruce X
31 Mulberry
32 ~~White B~~ Elm
33 Mahogany X
34 Bay wood
35 Horse chesnut
36 Brazil wood
37 Logwood
38 Locust

Woods continued

39 Lancewood
40 Butternut
41 Cottonwood
42 ~~Amaranth~~ X
43 X ~~Hemlock~~ X
44 X Pine (~~white~~)
45 Chestnut
46 Alder
47 Currant wood
48 Quince
49 Hawthorne
50 Walnut X
51 Cocoawood
52 Hazel
53 Red Oak
54 Peach tree X
55 Pepperidge
56 Sumac
57 Birdseye maple
58 Sassafras
59 Sycamore
60 Persimmon
61 Navy berry
62 Apricot
63 Greengage
64 Damson
65 French plum

Wood we cut up for loops, apl 17th 1880

Chas Batchelor

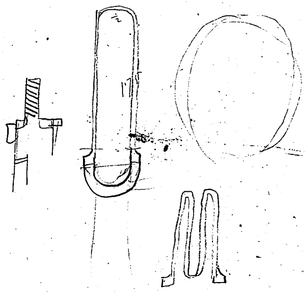
M A Force

66 Banana
67 India rubber tree
68 Briar (Sweet)
69 Lignum Vitae
70 Lion wood
71 Blood Wood
72 Cypress.
73. Slippery Elm
74 Tiger wood -
75 = Vegetable Ivory
76 ~~Shittam wood.~~
77 - Willow Wksps
78 - Goosberry
79 Sandal wood
80 Cocobola.
81 Lemon
82 Orange
83 Snuff wood
84 Date -
85 Grape
86 Fig
87 Lime Tree
88 Filbert
89 Juniper.
90 Escuylapias
91 Upas.
92 Bamboo
93 Olive
94 Grandilla
95 Guava,
✓ 96 Spicewood
97 - Citron
98 Pomegranite

99 scrub oak,
100 Chinconia..
101 aloe,
102 alianthus
103 acacia,
104 Magnolia
105 Buckeye,
106 Pecan
107 Sage bush
108 Manzanita
109 Myrtle,
110 Cork
111 Cascarilla
112 Croton,
113 Teak
112 Cranberry
113 Huckelberry
114 Misiltoe
115 Ivy
116 Dogwood
117 Linden
118 ~~K Pe~~ Gopher
119 Tamarack
Hackmatack,

Wood loops for Lamps Apl. 7th 1880

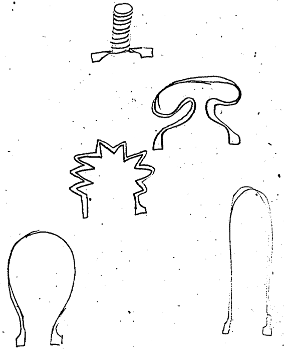
Chas Batchelor



120 Jarrinwood
121 Milkwood
122 Bread fruit tree
123 Mispel
124 Balsam
125 Prickley ash =
126 Witch Hazel
127 Lilac
128 Snow ball
129 Ashettic glow ball
130 Prickley pear
131 Barberry
132 Hornbeam
133 Aspen
134 Linwood
135 Leatherwood
136 Snake wood
137 Boxwood
138 King wood
139 Salesburia wood
140 Arbor vitae
141 St. Lucien wood
142 Plane wood
143 Palesanders wood

Wood loops for Lamps apl 7th 1880

Chas Batchelor

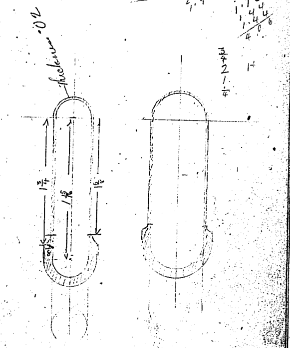


144 Zebra wood
145 Sellin
146 Coromandel wood
147 Angica wood
148 Calliatour
149 Bimas Sapan wood
150 Costarica wood (red)
151 Cuba wood
152 Viset
153 Campeachy blue wood
154 Tabasco blue wood
155 Domingo " "
156 Pistachio
157 Pernambuco red wood
158 Japan red wood
159 Puerto Caballo yellow w
160 Savanilla " "

New loop for lamps

Apl 8th 1880

Chas Batchelor

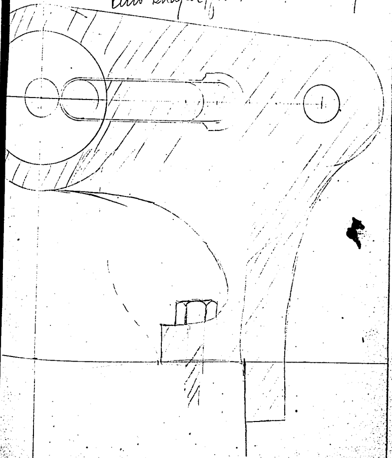


11.85 100.16 1.55

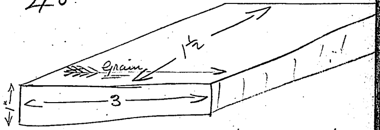
Apl 8th 1880
Chas Batchelor

Lamp carbons.

Bracket for little shaper to a former stud and shaper for new wood loops



Size of wood for new loops as made Watkins and shewn on page 45.



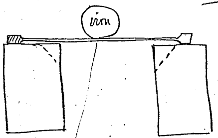
Make 2 of every kind of wood

2000,000

Loops for lamps

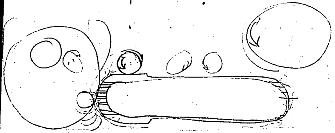
Apl 10th 1880

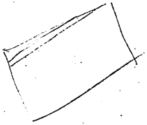
Chas Batchelor



Steam them here

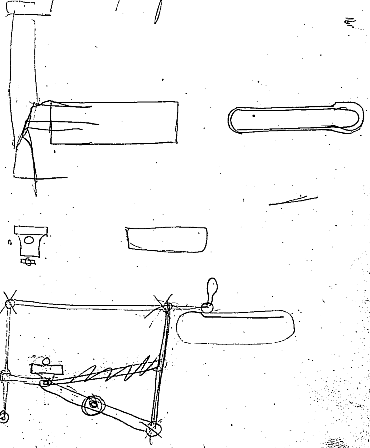
Steam only centre and iron weight will bend down slowly till it gets almost shape



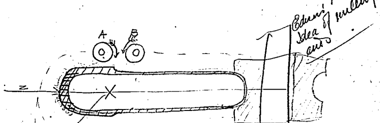


Apl 13-1880

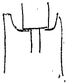
Very large former Chas Batchelor

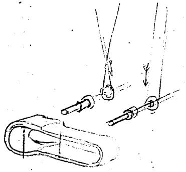


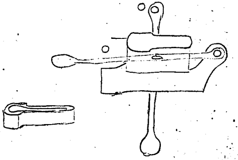
Wooden Cases for lamps / Apl 13/1880
Chas Batchelor

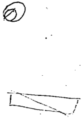


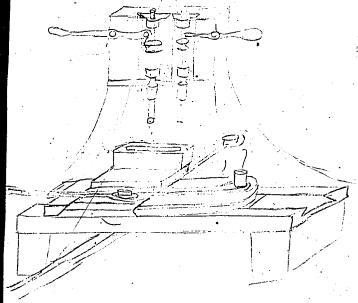
This is milled out first and put on a mandril then 2 cutters running in opposite directions operate on one side A running to left and B to right after passing centre line Z they are swung out of way and the wood turned over to do the other side

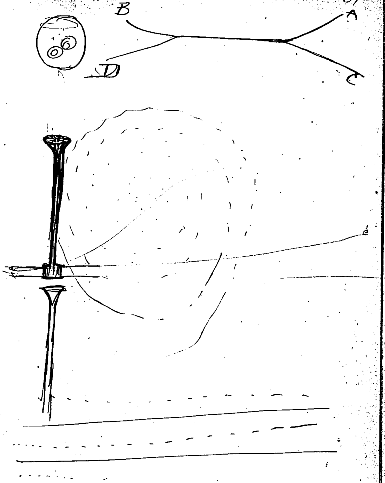


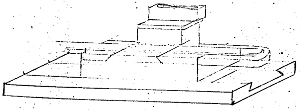


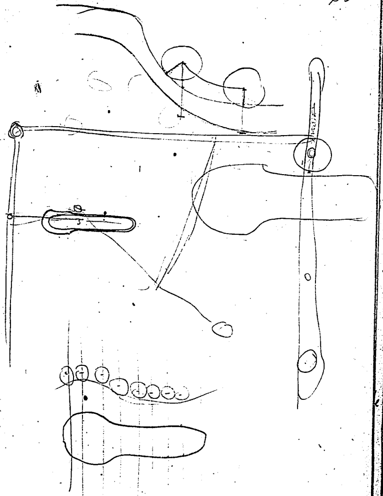


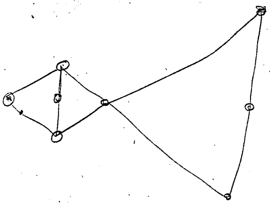


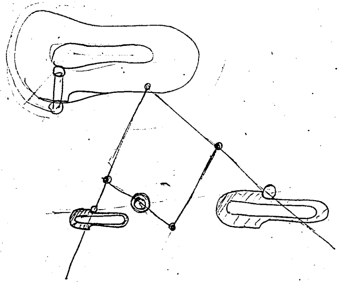



B
A
D
C





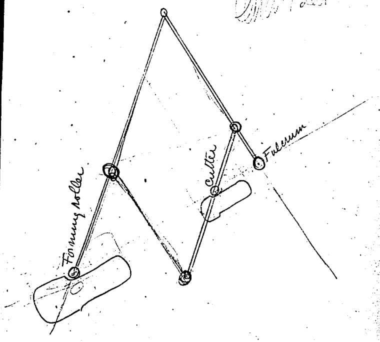


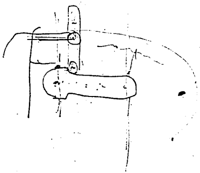


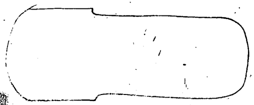
Former for Loops of wood

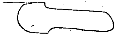
April 14/1880

Chas Batchelor

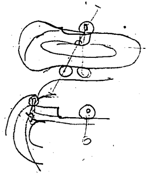


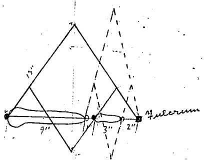


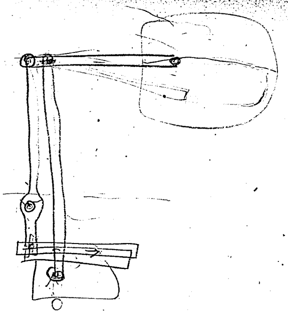


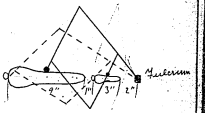


April 14, 1880









Can be determined.

74

New Machine for Cutting 75

Closed wooden hoops Apl 15 89

1 Cutter head ^block^ and bed to be same piece in order to secure rigidity

2 Both former and cutter spindle must work together on a slide with long bearing (so as not to have any shake) and moove about 3 inches

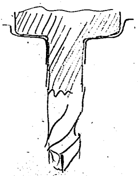
3 Spindle must run at least 6000 revolutions—7500 if possible

4 Former pin must be heavy right to point of working for rigidity

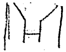
5 Cutter must be special of the Kind Known as (Boars Cock)

6 All the slides muste be square instead of bevil and fitted with gibs and screws

7 Spindle and former must stand upright and spindle end bearing must be made so that it will take oil in the shoulder so



Dean will make this just as he wants it



8 Back and forward motion.
slides must be extraordinarily
long to prevent shake

9 Former will be made with
$\frac{1}{4}$ hole instead of $\frac{1}{2}$.

10 Former will be a little
taper in outside and inside
and former pin also so that
any variation in cutter may
be rectified

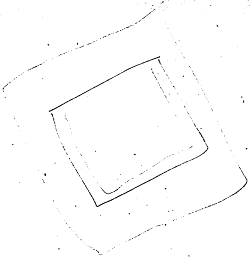
11 . Wood must be held by
jaws brought together by cam
lever — the inside jaw must
have two pins projecting so
~~that the [illegible]~~ when the

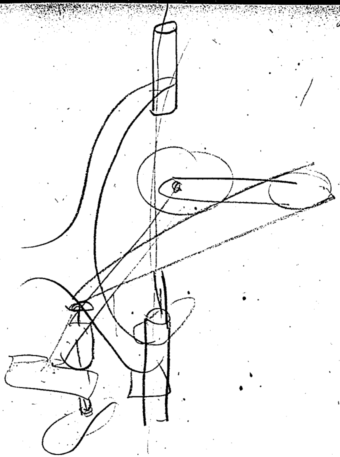
wood is in it is forced upon the
two points - This is, so that
they will come right in
place for finishing cut —

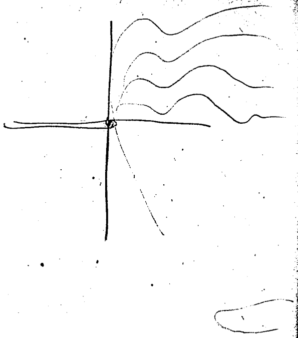
12. Where the cutter spindle bears
make large mass of metal
to conduct the heat away

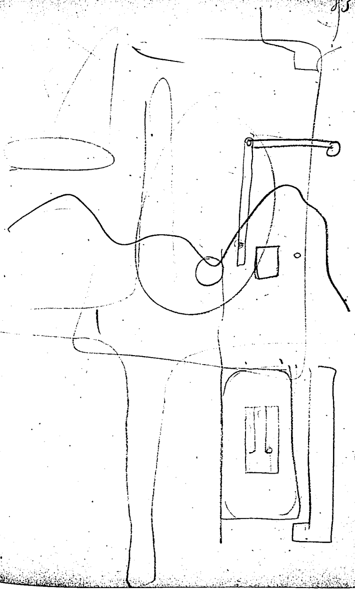
13 Both inside and outside
must be roughed out before
finishing

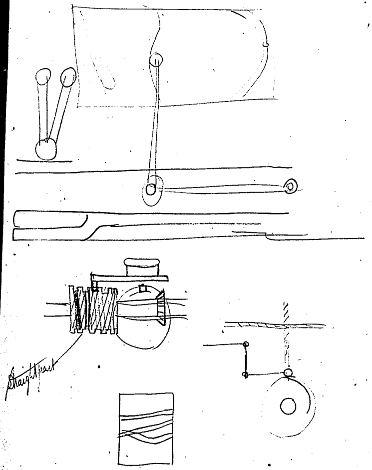
14

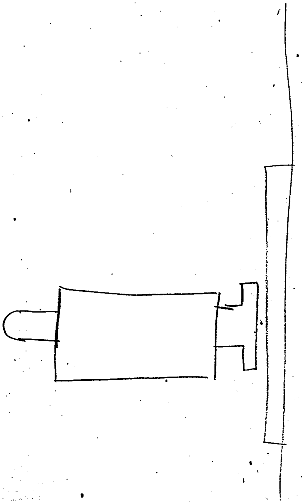


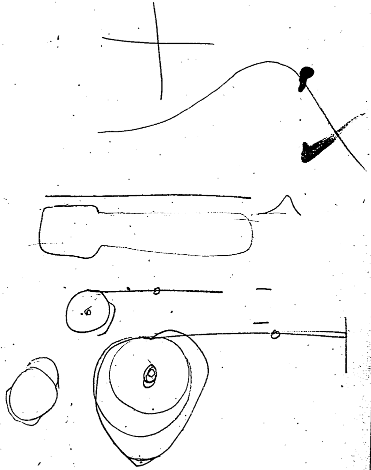







Straight part





Angle piece on slide carriage must go in 1½ inch upright carriage which must be cut out

·1560
1950
1·7179
1·9 29
179
9 2·108
10 179
2·287
11 179
2·466
179
12 2·645
179
13 2·824
179
14 3·003
179
15 3·182
179
16 3361

17/18

3361
179
3540
179
19 3719
179
20 3898
179
21 4077
179
22 4256
179
23 4435

No			
~~1~~ =	·05 · =	·0767	from periphery.
~~2~~ =	·17 =	·057	" "
~~3~~ =	·355	·118	
~~4 =~~	~~·600~~	~~·200~~	
~~5 =~~	~~·890~~	·297	
~~6 =~~	~~1·2·20~~	~~·407~~	
7 =	~~1560~~	~~·520~~	
~~8 =~~	~~1·750~~	~~·583~~	
~~9 =~~	1929	~~·643~~	
~~10~~	~~21·08~~	~~·703~~	
~~11~~	~~2287~~	·762	
~~12~~	~~2·466~~	·822	
~~13~~	~~2645~~	~~·882~~	
~~14~~	~~2824~~	~~·941~~	
~~15~~	~~3·0·0 3~~	~~1·001~~	
~~16~~	3182	1·06	
~~17~~	~~3361~~	~~1·120~~	
~~18~~	~~3540~~	~~1·18~~	
~~19~~	~~3719~~	~~1·239~~	
~~20~~	~~3898~~	~~1·299~~	
~~21~~	~~4077~~	~~1·359~~	
~~22~~	~~4256~~	~~1·419~~	
~~23~~	~~4435~~	~~1·478~~	

23 4435
179
24 4614
179
25 4793
179
26 4972
179
27 5151
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28 5330
179
29 5509
179
30 5688
170
31 5858
32 146
6004
33 154
6158
34 179
6337
35 179
6516
36 179
6695
37 179
6874
38 179
7053
39 179
7232
40 179
7411

40 7411
298
41 7709
282
42 7991
277
43 8268
256
44 8524
221
45 8745
195
46 8940
168
47 9108
115
48 9223
70
49 9293
028
50 9321

1.75
1.125
5.85
.81
75
9285

24	4614	1.538
25	4793	1.597
26	4972	1.657
27	5151	1.717
28	5330	1.777
29	5509	1.836
30	5688	1.896
31	5858	1.953
32	6004	2.001
33	6158	2.053
34	6337	2.112
35	6516	2.172
36	6695	2.231
37	6874	2.291
38	7053	2.351
39	7232	2.410
40	7411	2.470
41	7709	2.569
42	7991	2.660
43	8268	2.752
44	8524	2.841
45	8745	2.915
46	8940	2.980
47	9108	3.036
48	9223	3.074
49	9293	3.097
50	9321	3.107

1 ·34 = 2
·33
2 ·67 – 3
·29
3 ·96
·245 – 4
·205
4 1·205
·185 – 5
5 1·390
·12
6 1·510
·050
1·560

0	0	
1	·34	·113
2	·67	·223
3	·96	·32
4	1·205	·402
5	1·390	·462
6	1·510	·503
7	1·560	·52
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·03
30 1·590
07
31 1·660
·115
32 1775
·11
33 1·885
028
41 1·857
115
1·787
42 1·672
43 168
1·504
195
44 1309
221
45 1088
46

46 1088
256
47 ·832
277
48 ·555
·1282
·273
49 298
50

40 1885
·02
41 1865
6
42 1·805
·11
1695
43 ·16
1535
44 ·18
1355
45 ·22
1·135
46 ·26
875
47 ·27
·605
48 ·29
·315

	1360		
26	—		
27	—		
28	—		
29	—		
30	1·590	—	·530
31	1·660	—	·553
32	1·775	—	·590
33	1·885	—	·628
40	1·885	—	·628
41	1·857	1865	·62
42	1·787	1805	·60
43	1·672	1695	·566
44	1·504	1535	·501
45	1309	1355	·451
46	1088	1135	·378
47	·832	875	·29
48	·555	605	·201
49	·273	315	·100
50	—	0	0

1.125
1.125
75
75
2) 3.7 5 0
1.875

298
282
277
256
221
195
168
115
07
028
1.910

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.33
29
245
185
12
5
10
11
115
1.885

51 30
52 29
.59

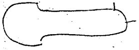
1.87
68 1.77
1.76
1.15
1.645
69 1.545
70 1.515
1.465
1.345
1.185
1.160

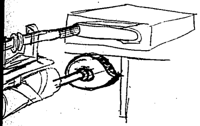
11.60
.97 2.45
.915

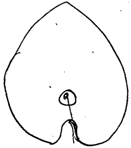
51 =	.30	.30 +	.10
52	.59	.59 +	.19
53	.66	.86 +	.29
54	.92	1.12	.37
55	1.14	1.34	.45
56	1.32	1.52	.50
57	1.48	1.68	.56
58	1.59	1.79	.59
59	1.66	1.85	.62
60	1.68	1.87	.62
61			
62			
63			
64			
65			
66			
67		1.76	.59 X
68		1.65	.55
69		1.545	.51
70		1.515	.505
71		1.515	.505
93		1.465	.49
94		1.345	.449
95		1.160	.39
96		.915	.305
97			

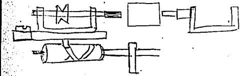
$$\begin{array}{r} 915 \\ 290 \\ \hline 625 \\ 330 \\ \hline 295 \end{array}$$

97	915	305
98	625	207
99	295	110
100	000	0



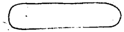






[illegible]

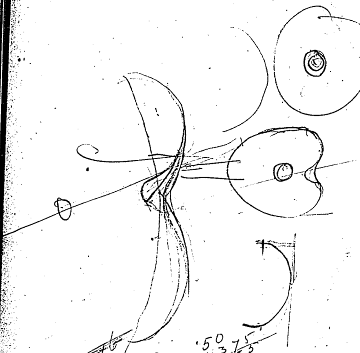
First put on block and run a $\frac{3}{8}$ bit
in and run it back and forward
to stops

Then put ~~two~~ cams on to work to
lines 

Put this on steel sleeve and work
with 2 cams for outside

Then saw off with the two cams
for hole

~~Width of Sides must be .015~~
thickness of sides must be .015



1/16

.0625

.4375

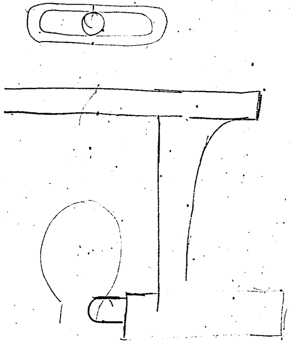
.4375 ÷ 3 = 1.3125

1.3125 ÷ 2 = .656

.50

.4375

.0625



Sideways

1		'020
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
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14		
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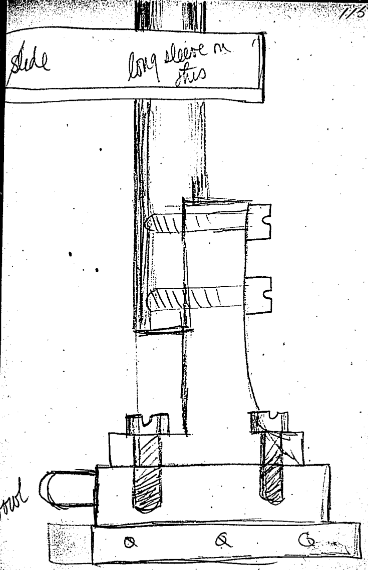
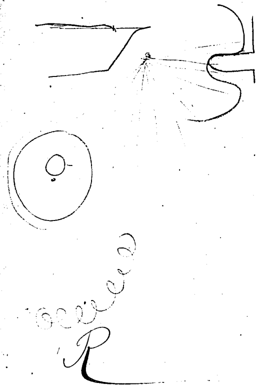
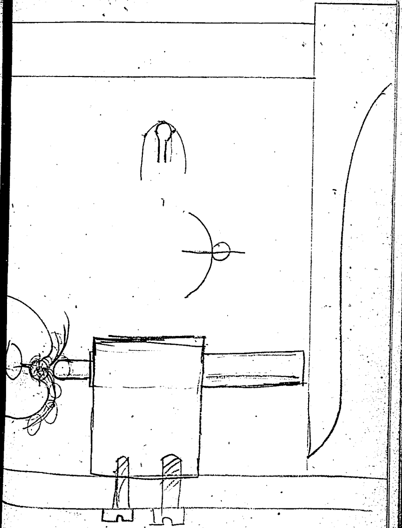


Slide
long sleeve on this
tool


R



6656
1.4
809

166
1.4
91

Clamps for Lamps . Apl 30th 1880

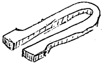
Chas Batchelor

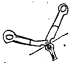
Make screw so:-

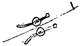
John Ott made these

Make clamps to screw down through the carbon

Old clamps and wires together weigh now ·810 mg
Old clamps and wires together in rough ·912
Old clamps and screw now in rough weigh ·766
Old clamps " " finished " " ·663
No 1 New pair ——— ·200



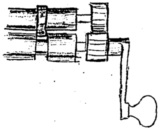


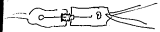


Making Clamps

Apl 30
1880
Chas Batchelor
E. C. Nott May 1.

Pair roller for rolling wire = this shape



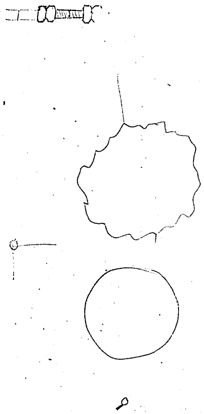


122

Clamps May. 4th 1880 123

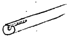
Ott made some nickel clamps and Copper ones too —

Chas Batchelor



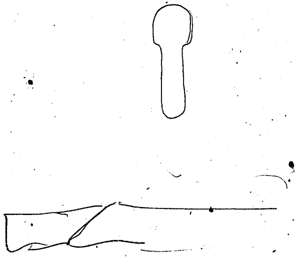
Lamp wires · May 6th 1880

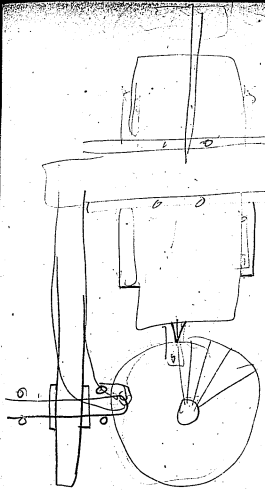
We gave over using solder to fasten the platinum to the copper wires in lamps and devised the following plan:-



The end of copper wire has a groove punched in it and the platinum wire is laid in and both fused together in blowpipe The platinum is then polished with bristle and flannel rolls.

Chas Batchelor





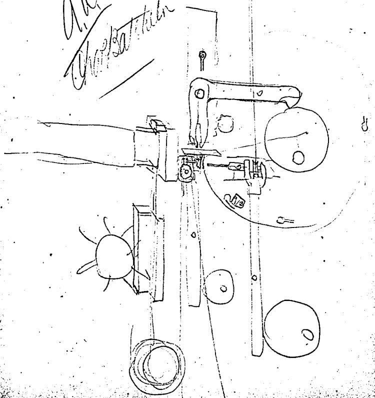
132

025 250 133

Clamp making machine May 6 1880

Fig. 1

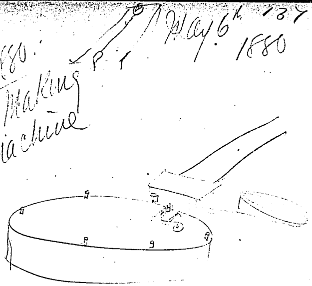
Chas Batchelor



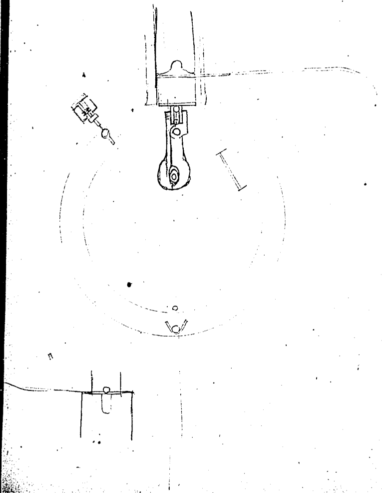
May 6th 1880.

Stamp Making Machine

May 6th 1880



T.A.E.
Chas Batchelor



$2\frac{1}{2}$

8

Cu SO_3

39/6

H SO_3

33

2

5

3000

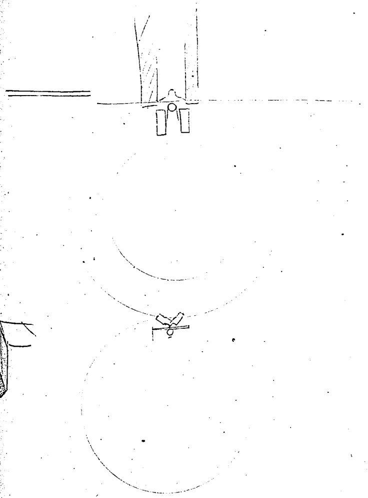
120

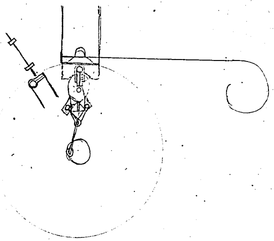
11

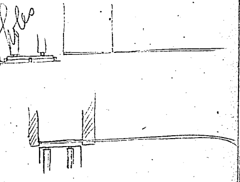
1320 / 15

72

540



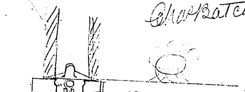


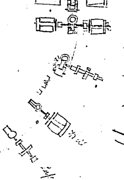


Punching the holes

Clamp making Machine May 8th 1880
1880

Chas Batchelor





Operations
1- feed in wire
2 { punch it and bend it
  { to an angle roundpin
3 { Jaws come forward on each
  { side and press to shape
4 { as Jaws recede a clamp

  { lets down to hold the
  { piece in position

5 Plate moves $\frac{1}{-}$ of a turn
6 Two magnetic drills one on each side — one drills through tapping size — and the other counterbores one side for body size — These two are on one slide and worked by same cam but one goes in as the other comes out.
7 Plate moves again and the hole is tapped
8 In moving the plate again the stud that holds

3000 inches
300

4/600
150

4/21

Diam circ. x 1/2 radius = area

20 X 10

3000
30.

100000.

100 =
x 13.

7854

20
3.14
62.80
314.00
3140.

10 500
x 26

20
20
441

10

25
x25

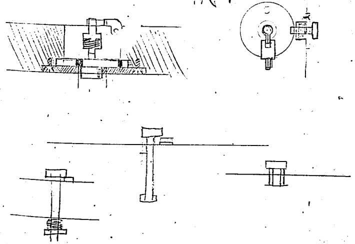
~~the~~ clamp pin etc is turned half round
so as to present its end to be drilled and tapped.

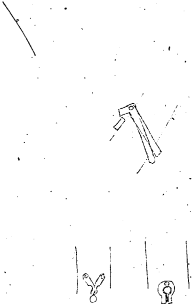
9= the end hole is drilled with magnetic drill

10 plate moves and a tap run in the end

•11 After leaving the last operation the stud turns back to original position and the pin is cammed down below the plate surface ~~to come~~ under the cutting off

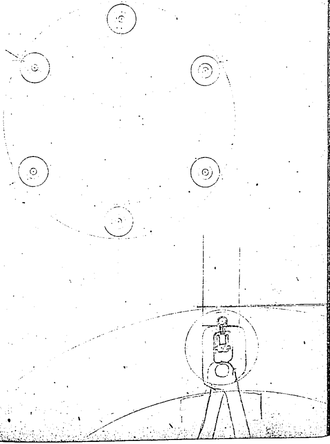
Sep 8 1880

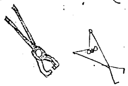


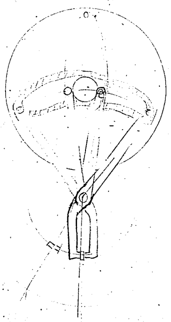


Lamp making
Machine

May 8 1881
Chas Batchelor

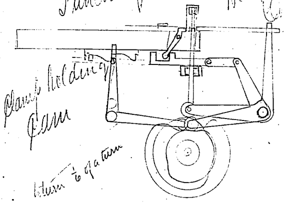






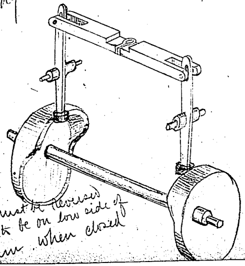
Punching Cam and May 8 1880 Chas Batchelor

Clamp holding Cam



1 turn $\frac{1}{6}$ of a turn

Closing Cam

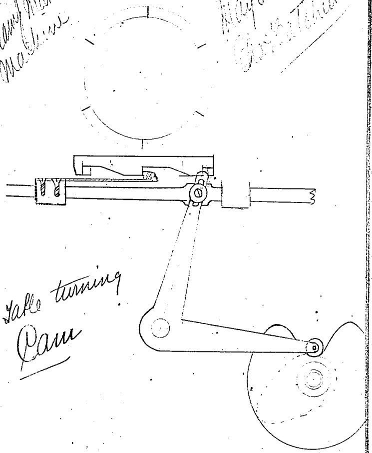


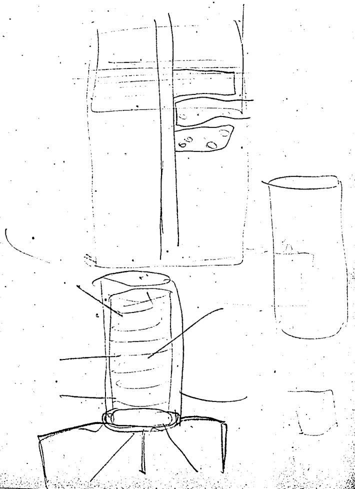
Here must be reversed so as to be on low side of cam when closed

Lamp making Machine

May 8 1880

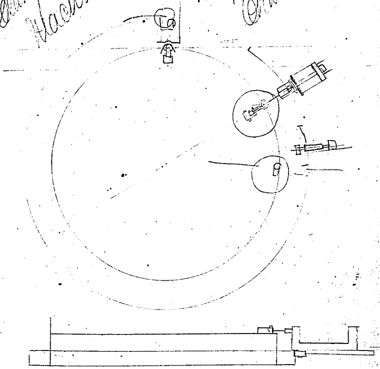
Chas Batchelor

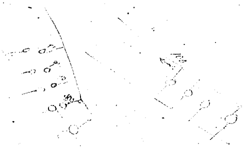




Clamp making Machine

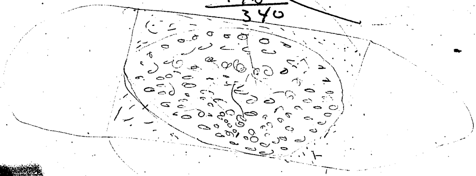
May 8 1888
Chas Batchelor





365
400
146000 M a year $18,000

146.)18.00(.12 cts per M
146
340



May 11th 1880

Babcock & Wilcox

Gentlemen

Can we with safety carry
120 lbs of steam on our
boiler and can you
fit the boiler with
self feeders blowers
grates [illegible] for burning
dust coal with the best
results,

Yours
T. A. Edison

300
60
56 | 18000

44

12 | 600
30
180
6

180
60
10800
5260

600
30 | 1500
50

9 | 300
336
19860
11880

Engine
14" drum · 2½ eccentric
gives 2 on drum
22 to 1 = 600 of Armature
30 Revol of Driver 24"
diam

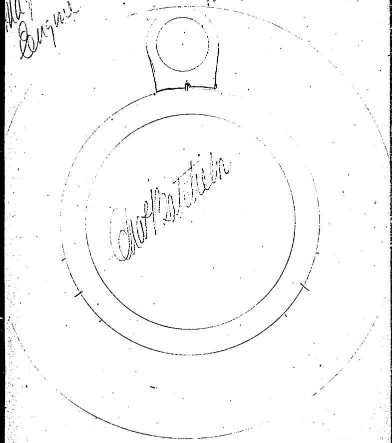
10
3

2½
9 | 1500
170
1020
60
5 | 61200
1

[signature]

Magnetic RR Engine

May 14th 1880



Chas Batchelor

5.50

3.5 | 900.0

1775

2.75

3.5 | 600

177

2.5 | 17.25

6

3.5 | 6.00

1 | 600

177

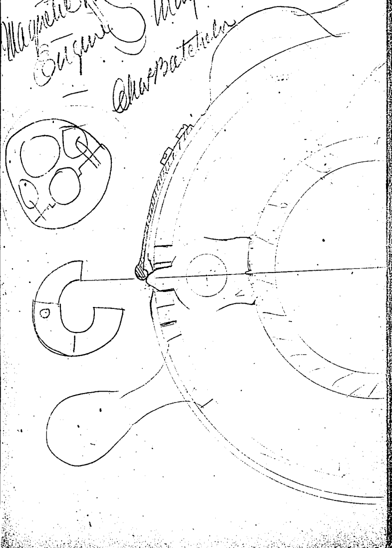
63

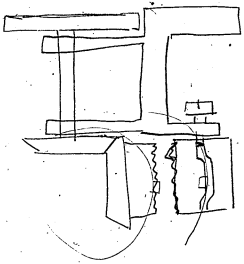
5700

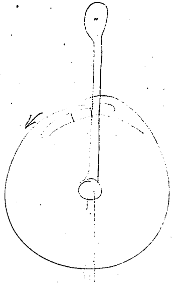
Magnetic RR Engine

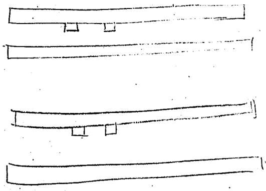
May 15th 1880

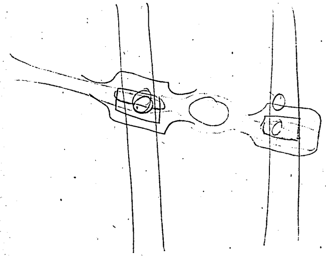
Chas Batchelor











60

$2\frac{1}{2}$

5.5
5.5
5.5
16.5
17.05

12.2

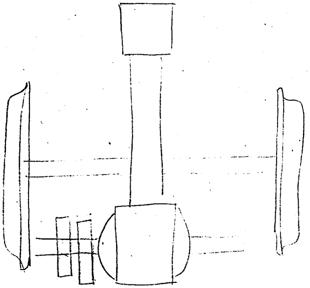
4600
2400
60
1440.00
7200
20

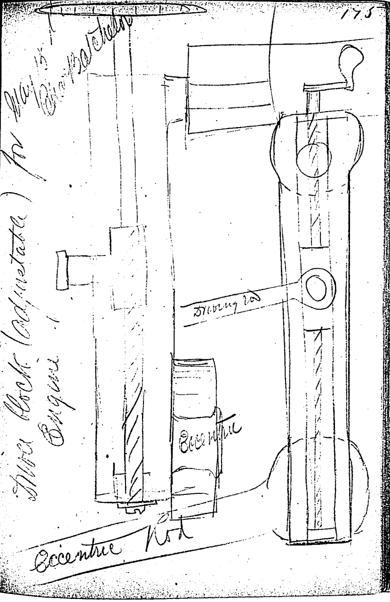
11 | 17.25
11.3

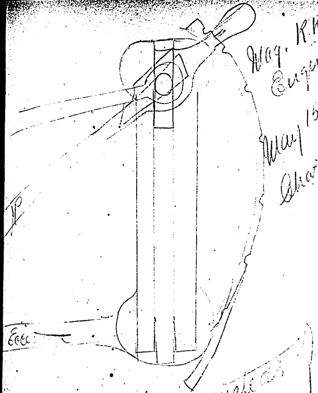
600

17 | 2400
146
8465

560 | 54
10.65




Driver block (adjustable) for Engine
Driving rod
Eccentric
Eccentric Rod

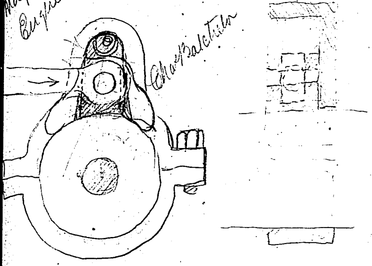


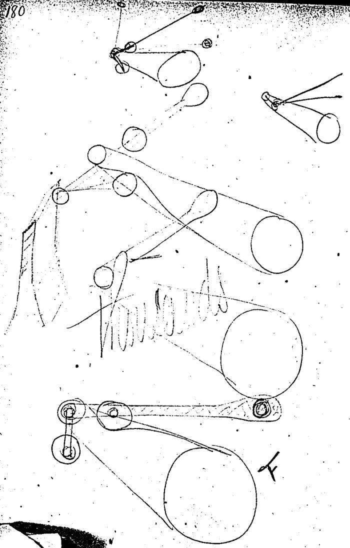
Mag. RR
Engine
May 13 1880
Chas Batchelor

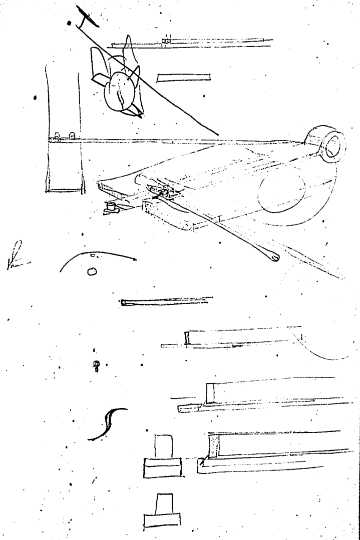
Driving lever instead
Screw

Mag R.R Engine

May 15th 1880

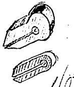






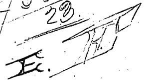
1·20

80 160



60 60

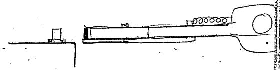
160 | 3600
23

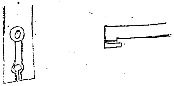


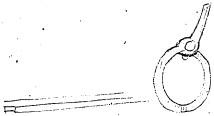
6 | 5280
6 | 884

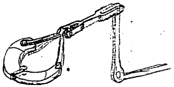
6 | 8800
144

Lamp Machine May 18th 1880









3 0
1 6

8
15

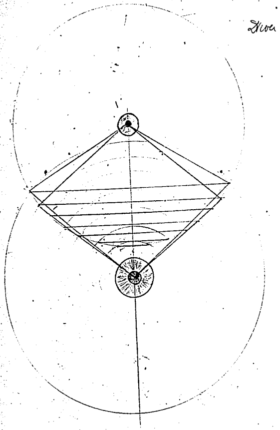
3 0 = 3 4/2
1 2

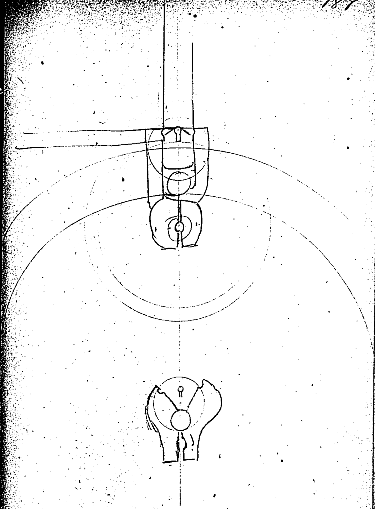
1000
8
8 0 0 7
30 / 2 7 0

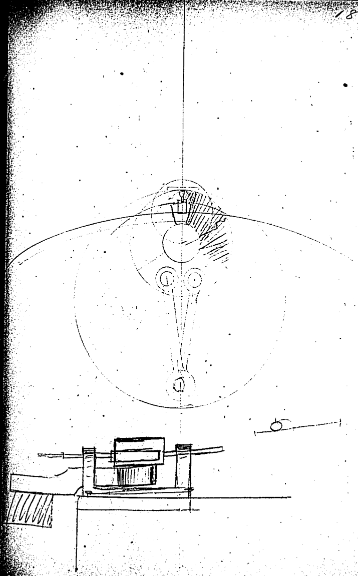
8
8

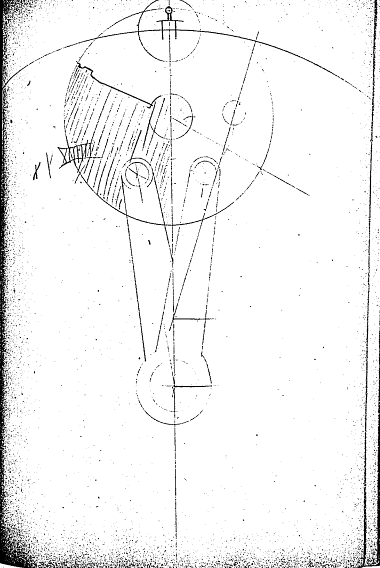
2 5 0 6
1 5 0 0 6 8
~~0 0~~
3000 / 9 0 . 6
1 1 . 8

Drwa Drown

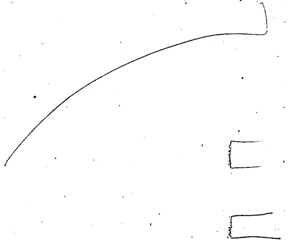




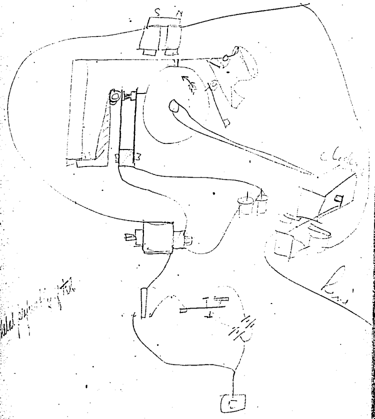




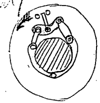
Louisville Ky

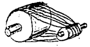


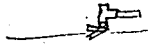
May 21 1880
TAE



RR. engine motions —
Driving

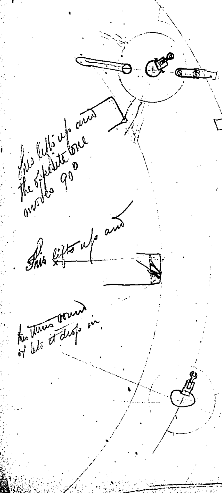


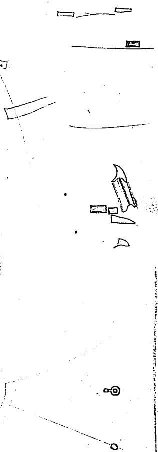




Clamp making Machine

June 7th 1880





In one turn of cams there must be made so 1 revolution 100 division

Cut and push on pin — Ratchet Cam moves back — } 30 div

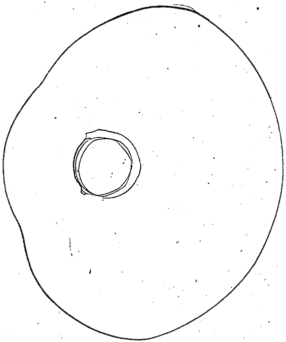
Bend to shape ~~Cutter moves part back~~ } 14

Catcher holds it Cutter move part back } 13

Bender and Catcher Cams move out } 13

Ratchet moves 1/6 — 30

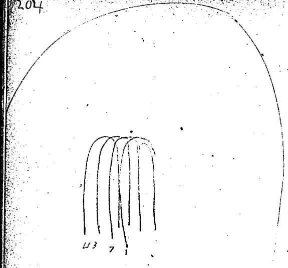
Drilling and tapping cams must be divided ~~into~~ 100 and do all their work in 70 as it takes 30 to move



No 1 Cam – Cut off

Use $6\frac{1}{8}$ lever to cam
and $4\frac{1}{8}$ " to
Cutter moves $\frac{13}{16}$ = Cam bowl lifts
$1\frac{5}{16}$

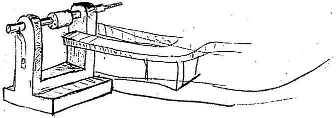
Cam lifts $1\frac{3}{16}$ in 30 division
waits 14 division
Moves back in 26 divisions
Dead for 30 division

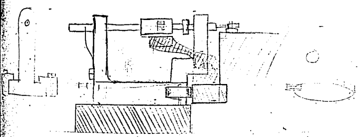


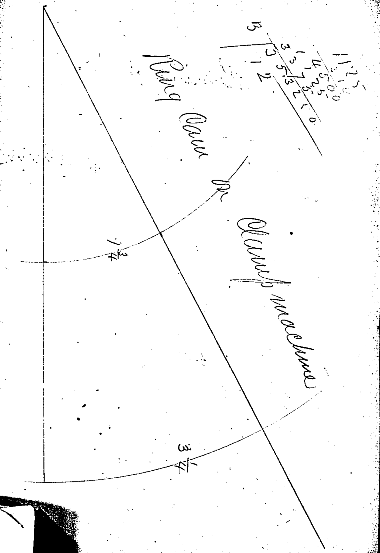
Clamp making Machine

June 7 1880

Chas Batchelor







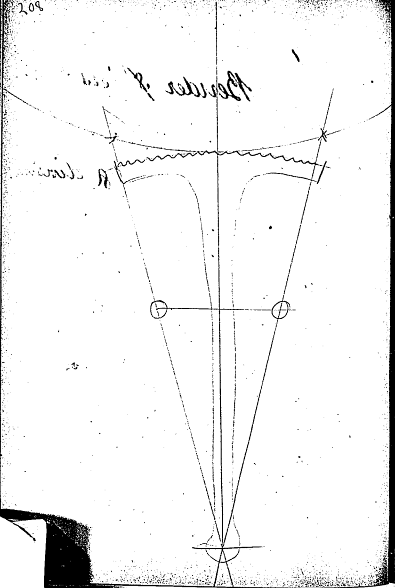
No 2 Cam

Bender Shiers
Left hand

Dead for = 26 divs.
~~Rises~~ $1\frac{1}{4}$" lifts 18 division
~~Dead~~ 13
18
Moves out 25
Dead

OK

Lever $4\frac{1}{16}$ lifts $\frac{7}{8}$
Bowl lever $6\frac{3}{4}$ lifts $1\frac{1}{4}$
$1\frac{3}{4}$



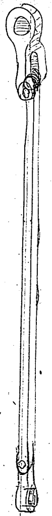
No 3 Cam

Catch for holding little clamps
round pin

Dead	44 dw
raises 5/8 inch	13
draws in	13
Dead	30

lever 4 in — raises 5/8
Bowl lever 4 in

OK



No 4 Cam ~~(Ratchet.)~~

Lowers ~~inch~~ 1 $\frac{11}{16}$. $\frac{1}{4}$ $\frac{1}{32}$ 44

1 $\frac{31}{32}$.

Dead 26

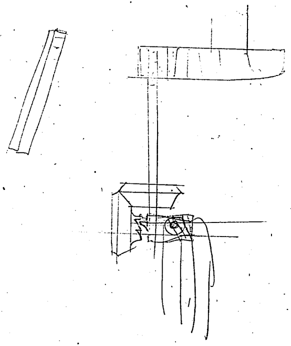
Raises ~~1~~ inch 1 $\frac{1}{16}$ high 30

Bowl lever 6 $\frac{1}{4}$ ~~1~~ 1 $\frac{11}{16}$

Driving lever 4 $\frac{5}{16}$ — ~~1~~ 1 $\frac{3}{16}$

JK

08



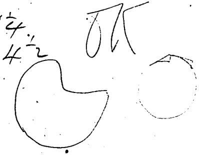
No 5 Cam-

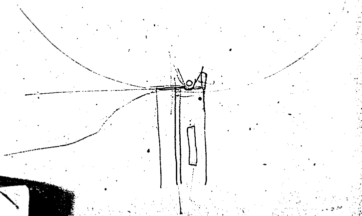
Stop pin

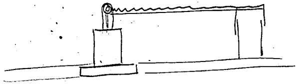
Dead		60
Raises	high	90
		~~24~~ 1
Drops		30
Dead		

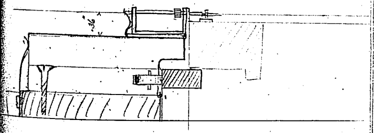
lever $3\frac{1}{4}$

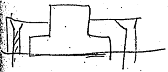
Bowl lever $4\frac{1}{2}$

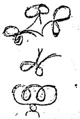






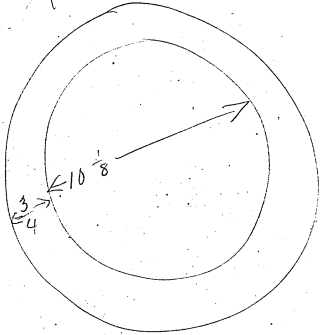

.36



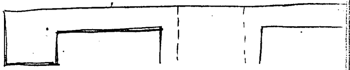


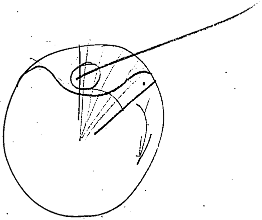
9 9
3 3 3
1/4
10

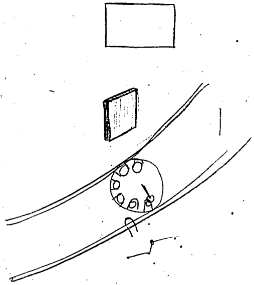
9/16 thick



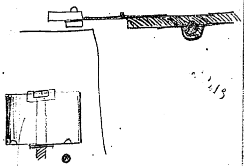
18.4
5 5 2
1 2
6 2 4

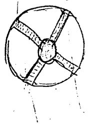




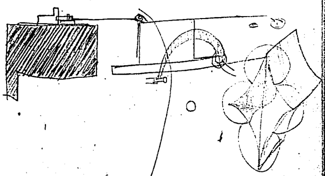


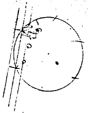
Edison



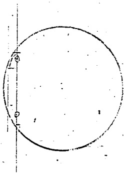


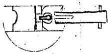
Chas

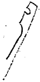




2235



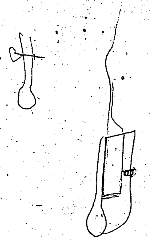


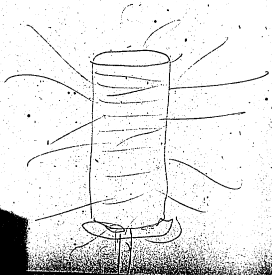


Bast fibre made by Bradley

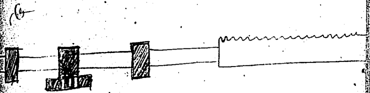
·009 thick } cut to guage for length
·011 wide }

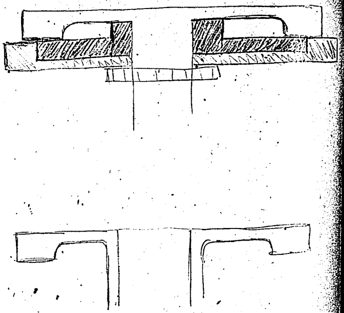
Resis after Carb.
length after Carb.
Shrinkage

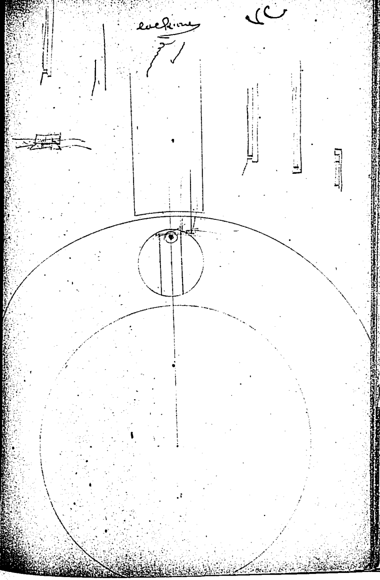




Make







4000

$$443 \frac{E^2}{R} R = 4000$$

$$443 \frac{E^2}{R} = \frac{4000 R}{R} \qquad R = 500$$

$$\cancel{E = \sqrt{\frac{4000}{R}}}$$

$$\cancel{800} \quad \frac{4000}{8.}$$

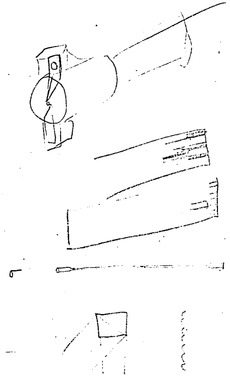
$$E^2 = 4000 R$$

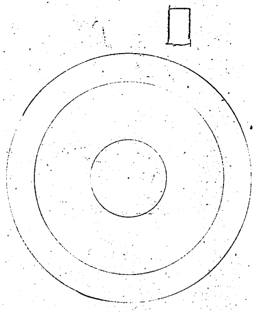
$$E = \sqrt{\frac{2{,}000{,}000}{443}}$$

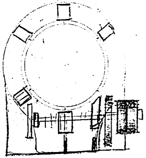
$$\doteq 1{,}400$$

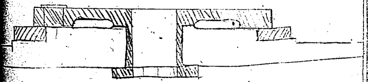
212

$$\begin{array}{r} 6.3010 \\ 1.6464 \\ \hline 4.6546 \\ \hline 2.3273 \end{array}$$

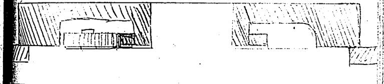


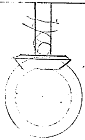




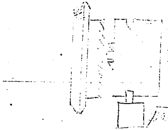


June 28th 1880





Device for ratchet movement for Clamp machine



stationary guide

$D' = \frac{N}{P} =$

$D' = \frac{D \times N}{N+2}$ 32 $\frac{100}{32} =$

32) 100 (3·125
96
40
32
80
64
16

4 · 3/4
19 8
15 2

6 3/8 5 1/4 150
4 9/4 204
19 6 100 × 50

4.78 / 3.14

72 ~~teeth~~ at $\frac{1}{8}$ pitch =

$\frac{72}{8}$ = 9 in circum = 2·86

$\frac{120}{8}$ = 15" circum = 4·78

$\frac{20}{8}$ = 2½ " circum = ·80

$1 \cdot \frac{12}{18} =$

$32\,|\,102\,|\,3.18$

$3.14\,|\,10.00\,|\,3.18$

$150\,|\,3.14\,|\,300$

200

$\frac{N}{P} = \frac{25}{32} =$

$32\,|\,25.0\,|\,0.8$

$314\,|\,3000\,|\,09$

$\frac{30}{32} = 32\,|\,300\,|\,0.94$

$\frac{20+2}{32}$ $\frac{20}{32}\,|\,220\,|\,0.7$

100 teeth 32 pitch

Pitch line $= D' = \frac{N'}{P} = \frac{100}{32} = 3.125$

Outside diam $= D = \frac{N+2}{P} = \frac{100+2}{32} = \frac{102}{32} = 3.18$

30 teeth 32 pitch

Pitch line $d' =$

3.18

25 teeth = pitch line .8

30 teeth " .94

25 =

D $\frac{25+2}{32} = \frac{27}{32}\,|\,270\,|\,0.84$

$\frac{30+2}{32}\,|\,1.0$

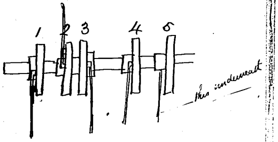
$$\begin{array}{r} 144 \\ 4 \\ \hline 576 \end{array}$$

243

$$\begin{array}{r} 210 \\ 420 \\ \hline 417 \end{array}$$

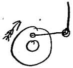
Clamp Machine Sept 7th 1880

Cams 1
2
3
4
5



1 is Stop pin Cam
2 is Bending Cam
3 is Punch Cam
4 take off
4 Ring Cam

All divided into 100 Divisions



No 1 Dead 60 div
Raise 9
Drops 1
Dead 30

No 2. Binding Skeis 

Dead for 26 div.

falls [illegible] incl " 18 " 36 35 30

dead for 13 "

~~Moves~~ Raises " 18 "

Dead for 25

No 3. Cutting Off Cam 

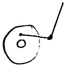
1st Falls for 30 div.

Dead " 14 "

1st Raises " 26 "

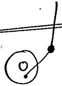
Dead " 30 "

No 4 Take off Cam



Drop $\frac{3}{4}$ in 41 Div.
Dead ~~17~~ 11 —
raises 48 "

No 5



Drops $2\frac{1}{16}$ = ~~20~~ Div
Raises $2\frac{1}{16}$ — 30
Dead — 30 —

5000
5000
25000000 00
44
100000000
1332118088
110,000000
10

33 000) 110 000
99
11

3333
33
9999000
9999
109,989,000

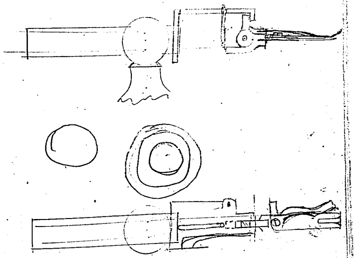
3333
6666
13,330
26600

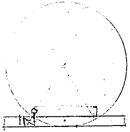
5
2 1/3
1 1/4

Take off for Thumb &c.

July 1—

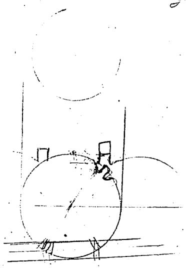
[illegible]

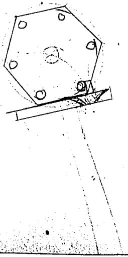


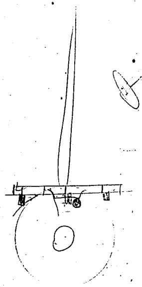


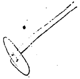
July 1

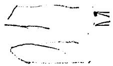
John F Ott

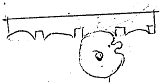


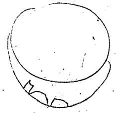


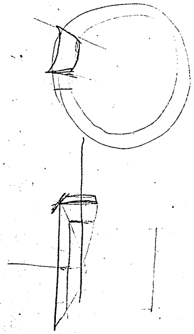


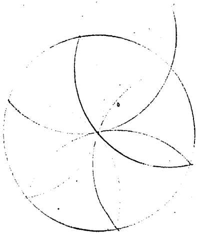










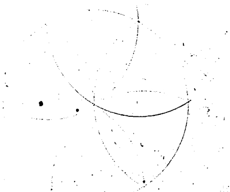


276

Practical treatise on Sea Sickness
G. M. Beard published by
E. B. Treat.

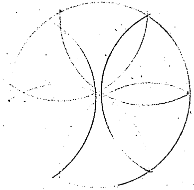
S M Bennett 141 8th St
Self Contradiction of The Bible

Ladies Cooperative Dress Ass.
112 5th Ave N.Y. Circular



277

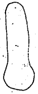
Badger What are they doing
with telephone — have they
got any central system
yet — & whose etc?

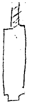


278

30000
30

12/900.000
75.000
15000

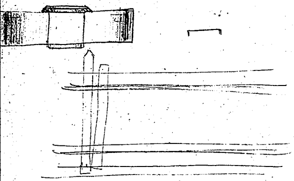


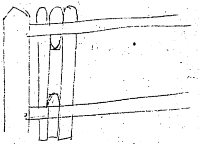


283

1000 HP conductor 30 miles 3 in
one would only realize 373 Hp -
and a

6½ X 4½





Menlo Park Notebook #52 [N-79-07-31]

This notebook covers the period July 1879-January 1880. Most of the entries are by Charles Batchelor. There are also entries by Edison and A. Poinier. The name of James Seymour appears occasionally as a witness. The first part of the book contains notes and drawings of experiments on metal filaments. Many relate to insulating materials used for coating the filaments. The second part of the book contains notes and drawings relating to the important series of experiments conducted in October 1879, which led to the invention of the carbon filament lamp. There are also notes and drawings documenting the development of the carbon filament through the end of 1879. A special cover placed over the book contains a label indicating that this notebook was used as an exhibit in the case of Edison Electric Light Co. v. U.S. Electric Lighting Co., in which Edison's patent on the carbon filament was sustained (see Litigation Series). The book contains 280 numbered pages. Some pages have been torn out of the book.

Blank pages not filmed: 54-55, 108-109.

Missing page numbers: 217-218.

Con E L Co
vs
McKeesport Co
Degrs Exhibit
Batchelor note book
1052 March 7, 1889
W.J.D.
S.E.

July 31st 1879

Chas Batchelor

~~Exp~~ Pyro Insulation

Acetates.

Acetate of Calcium is decomposed by heat into Acetone ~~and~~ Carbonate Calcium

All ~~carbonates~~ acetates which decompose easily and form stable carbonate do same thing —

If so, then ∴ our coating is a Carbonate of Magnesia & the carbonate has to go off under high heat as

Carbonate Calcium strong red heat
" Barium white heat
" Magnesium intense heat

the decomposition of Carb. Calcium commences at a low red heat! so that in ~~[illegible]~~ heating a wire of this covering it should be left at low red for a long time

Pyroinsulation

Nitrates.

Nitrate Calcium is decomposed at a comparatively low temperature.

Nitrate of Lanthanum at red heat is completely decomposed leaving light brown oxide

July 31 1879

acetate Zinc - TAE Chas Batchelor

Will not coat a wire after 30 dippings - but the surface of Pt is slightly roughened as if zinc reduced and combined. perhaps the lampblack of candle reduced it, there is a slight change in the metallic color but not the slightest trace of an oxide

Acetate Cerium -

No oxide - attacks platinum, like zinc, but there are iridescent Colors

acetate Calcium

coats easily at low heat but is very easily rubbed off and when bent it peels off in shreds

itrate of Calcium TAE

will not coat at all and after 20 dippings does not seem to affect the wire

itrate of Cadmium

Difficult to get anything on at all and after you get the brown oxide on a red heat takes it all off again —

trate Magnesium

Considerable trouble to get it on even, though a coating can be got on affects platina as much as the Acetate

8

Aug 1st 1879 9

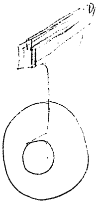
Chas Batchelor.

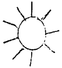
TAE

Zirconium Acetate

Coats very well indeed I think a little better than Magnesium It does not affect the wire and will bend very short. It is very hard to get off. Wound a piece of .004 wire which was coated with Zirconia, and made all the spirals touch and then put 9 cells C+H battery through it, It gave good light (white) and on examining under the microscope after it seemed to have lost nothing but the covering was slightly browned the acetate must be evaporated down to a syrupy solution ———

TAE





Aug 10 1874

Electric Light   Aug 10th 1879   13

Coating Wires for Lamps.   Chas Batchelor

1 Took 32 in of .004 20/o Platinum Iridium wire and brought it up in vacuum taking 20 minutes, then covered it with .001 Zirconia. After commencing to coat, the wire broke in my hands and the two ends of wire shewed structure like this  as if one half of section was crystals of a blackish grey color.

See page 16

T A E

14

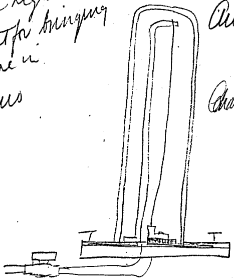
Electric light

[In]strument for bringing [u]p the wire in Vacua

Aug 10 1879

15

Chas Batchelor



T A E

16

TAE 17

~~He~~ This happen'd a number of time and Edison thinks it not so much due to the wire having flaws, as to some change produced in the wire during the process I put it through. We now began to investigate it & found ~~that~~ ·004 20/ platinum Iridium would stand a breaking strain of 2½ lb, and every time it broke, it would either show a well drawn out (center punch) point or a chisel point showing that the wire stretched down till it finally broke. ~~thus~~ so:—

These breaks were not at all like the breaks made when they broke in my hands without pressure which showed a crystalline ~~structure~~, and broke off sharp —

If we brought up a spiral of one layer on a lime cylinder it gave a splendid light, and would never cross in the spiral; but when heated too much, the leading wires would go first; but if we made the Spiral of two layers, there seemed to be something that crossed the bottom and top in between before

it had got very hot, always cutting out half the spool almost immediately, and gradually cutting out till there was nothing left but the few bottom turns in circuit. Whatever it is that crosses, seems to move around between the layers as if it was a liquid conductor! It seems as if the Zirconia itself at such a heat was a conductor, which shows itself plainer on the 2 layers, because, there are points between the bottom and top layer of considerable tension especially at bottom

See Page 25.

T A E

32

Electric light
Coating wires

Aug 10 1879 33

Try baking on the coats at about 200 Fah. and when on thick enough bring up very slow indeed. Take 10 short pieces and coat thin and put in oven—

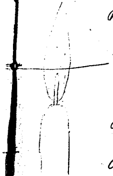
TAE

It may be however that it is due to impurities such as silica in the Zirconia and also from the lime.

We tried to coat the wire with light coating of Zirconia acet and then put on coat of acetate Magnesia after bringing up the spiral and looking at under the Micro. we found that the Magnesia was almost all gone but the Zirconia was on in a dense vitreous mass.— TAE

The best way I find to coat the wire is to evaporate the

acetate of Zirconia down till it
shows a slight milkiness with
some white sediment and then
& rub between your fingers slightly
till it feels slightly sticky and
apply to the wire by rubbing be-
tween your fingers till they
become almost dry then pass
the wire through the candle flame



not in the very hottest part but
~~[illegible]~~ just above the
wick so that it never gets
above a low red. I am
always careful that the

wire is never so wet that the heat of candle makes it spurt in the least ______

We find that equal mixtures of Acetate of Zirconia and Acetate of Magnesia make a good coating which looks very fine after being under the action of great heat

Aug 10th 1879
Chas Batchelor
TAE

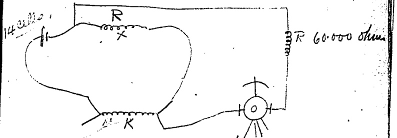
August 11 1879 T.A.E.
Chas Batchelor

Tried strong acetate Titanium Pure, Could not get the slightest trace to adhere to the wire. it was somewhat syrupy. I found that some crystals formed by evaporating it to a syrup got on fingers and scratched the Platina wire,

Tried - Nitrate Strontia - syrupy - got Strontium color in candle, could only get it to adhere in drops, this looks as if there were impurities in the salt although its one of Kellys pure

Wire coating

TAE



2 wires coated + twisted together

~~1 Cell Battery~~

~~Battery~~	~~Res at X~~	~~Deflect~~
~~1 cell~~	~~700~~	~~0~~
~~1 "~~	~~50~~	~~1 degree~~
~~1 "~~	~~40~~	~~6~~ ~~2 degree~~

Aug 12 1879

T A E

Titanium Ox,
Stannic Ox,
Aluminium Ox
Zirconium Ox,
Silica
Thorium Ox,
Chromic Ox
Tungsten Hydrate

All form gelatinous oxides and therefore will fuse down to vitreous mass

---

Edison Tried Titanium Acetate.
it may coat the wire when exceedingly syrupy on the finger-fuses whilst putting it on, and globulate on the wire, forming beautiful amethyst globules

on the wire. which run up hill — It does not attack the wire —— T A E

Chloride Ziconia

This is very difficult to get on the wire. and only goes on very rough. I ~~thought~~ at first it affected the wire considerably but find that it only slightly attacks it

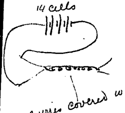
—— Chas Batchelor

Zirconia Hydrate-

Coated a wire with this which is fine gelatinous Zirconia in water — Could only get on very thin coating but Spiral made of it stood very intense heat without fusing ——

Aug 12.

We find ~~that~~ the battery put on two covered wires so: TAE



covered with Acetate Zirconia did not connect, but if a spirit lamp was applied so as ~~to~~ heat them up, they would make circuit as soon as it got a little above a red. The point where it would make connection always showed as if some impurity in the covering had been present and attacked the platina changing it in some way. The platina does not show globules at these points as it generally does when it

40

Coating Wires for Electric Lighting Aug 12 1879

T.A.E.

melts or runs together, but seemed to show a crystalline fracture.

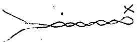
Edison wound a couple of wires together that had been covered with Alumina and these did not cross under the same conditions nor yet when heated by the blowpipe ———

Chas Batchelor

Electric Light Aug 13 1879

Covering Wires TAE Chas Batchelor

I took 6 wires and covered them with Acetate Zirconia, and brought them up to white heat and then doubled them up and twisted them together and connected battery to two ends and then cut the end at X,



on applying the heat of a spirit lamp to this when the battery of 14 cells was on the two ends

Tiol

they all acted alike and crossed at a little above a red heat. Now as our wire is pretty pure and our Zirconia we have taken particular pains to have pure we must come to the conclusion that the Zirconia must be a conductor at that temperature

46

Electric Light Aug 14 1879
Coating Wires Chas Batchelor

Coated a 32 in. wire with Chloride of Aluminium ·003 thick and wound in two layers on spool. This coating when on spool broke off a great deal but for all ~~that~~ it was brought up to a brilliant white heat (though not to perfect incandescence) before it melted ~~at~~ ~~at~~ the bottom of spool. Under the microscope it did not

TAE

seem to have been caused by
the tension, but seemed to have
melted the first three turns on
the bottom layer and broke
the wire. Now the only
difficulty to be overcome is the
coating the wire so as to stick
like the Zuconia and not
crack when wound on small
spool. This wire was platinum
and was not brought up

58

Electric Light
Wire Coating for
Pyro Insulation

Aug 14 1879 59

Chas Batchelor
T A E

Took some Quartz (Si) and powdered up fine and coated a wire by mixing it in water and putting on that way — a spool of 2 layers came up very good showing perfect insulation and under the microscope showed clean melt with the coating melted down to perfectly clear glass-like coating —

Silica Coating

Under the Oxy. Hy. flame the following
pressed cylinders acted as follows:— TAE

Zirconia —

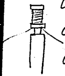
56

Electric Light
Coating Wires for
Lamp insulation

Aug 18th 1879 57

Chas Batchelor
T A E

In bringing up the small lime spools with 2 layers of ·004 platina wire, we always find it hottest in the middle, owing to the conduction of heat away by the lime bobbin; I took



one and made thin top and bottom so-

and now, when brought up the heat seems to be much better distributed; at the low red even little difference can be seen ———————

Electric Light
Pyro Insulation of wires

Aug 19/79 59
TAE
Chas Batchelor

In coating with Corundum, if we could coat with very low heat (such as holding over a kerosene lamp) it would save the trouble of first bringing up the wire and also prevent the cracking of the wire due to the heat of gas jet

I used for this purpose a little dextrine in the coating liquid, this is not ~~very~~ good although a light coating can be got on with patience. I tried various quantities of dextrin but with no better effect

Tried same with Gum Tragacanth and Isinglass but although a coating can be got on it is immediately rubbed off by the hand.

Electric Light
Silica Spool for lamp.
TAE

Aug 22nd. 1899

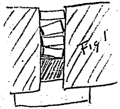
Chas Batchelor

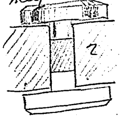
I Powdered Quartz (Si) and finely divided it by water so as to press it into a cylinder —

Find it difficult to make a hard solid cylinder of it dry as it powders on being rubbed by hand like Sandstone

Tried a little Dextrine and Tragacanth with it - No good

Find that on our mould we cannot get the pressure we want on the material as the discs will not allow it. We find that when six discs are in if they are not perfectly





flat they must stand as in Fig 1 and consequently

It requires so much power to press these down to place that it crushes some of the discs before it brings the material to a perfectly solid cylinder. Now we propose to press them down to $\frac{3}{4}$ long in this and then put them in another ~~press~~ die like 2 and press them till the two heads come down to bed on the die which will make it $\frac{1}{2}$ inch: In this the enormous pressure comes direct on the material and is not transmitted through a number of steel buttons which have possibly untrue surfaces.

Sept 6th 1879

Lime powdered up fine & placed in two moulds is exceedingly hard

TAE

Sept 8 1879

Spools for Electric Light TAE

all pure chemicals

No 1 — 20 Alumina 80 Lime

2 — 20 Magnesia 80 Lime

3 — 50 Alumina 50 Magnesia

4 — 80 Alumina 20 Magnesia

5 — 50 Alumina 50 Strontia

6 — Pure Alumina pressed once

7 — Pure Silica

8 — Pure lime pressed once

9 — Pure Zirconia

10 — Cadmium Oxide

11 — Magnesia pressed once & powd-

12

Chas Batchelor

Dept 11th 1879
KAE

Lamp spools for Electric Light

$$\begin{array}{r} .166 \\ 3.14 \\ \hline 664 \\ 166 \\ 498 \\ \hline .52124 \\ .4375 \\ \hline 260620 \\ 364868 \\ 156372 \\ 208496 \\ \hline .1842 82500 \end{array} \qquad \begin{array}{r} .093 \\ 3.14 \\ \hline 372 \\ 093 \\ 279 \\ \hline .29202 \\ .085 \\ \hline 146010 \\ 233616 \\ \hline .02482170 \end{array}$$

$$.0248 \,)\, .18428 \,(\, 7.5$$
$$\begin{array}{r} 1736 \\ \hline 1060 \end{array}$$

1001

10

2/4

Small spool. (Helix) Sept 22nd 1879 TAE

$.166 \times 3.14 \times .4375 =$

$.52124 \times .4375 = .18428$

Large such as we used in shop

$.093 \times 3.14 \times .085 = .0248$

difference

$.18428 \div .0248 = 7.5$

Relative size of a small spool such as we bring up in a vacuum & the size we lighted up shop with.

We got from small one 8 candles therefore the large ones ought ~~to give~~

$8 \times 7.5 = 60$ candles

Chas Batchelor

Electric Light — Sept 24th 1879

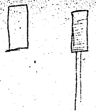
Lamp spool.

T. A. E.
Chas Batchelor

New method of winding spools:—

I wind one layer on the spool and fill up between the convolutions (which are slightly apart) with a thick solution of Acetate of Magnesia and Alumina put on by a brush; this is then baked at about 250° Fahr, and then another coating is put on + baked again; these are continued until the wire is entirely covered and about .01 inch above the wire; another layer is then put on and this is set by a few brush-fulls of the solution—

Portland



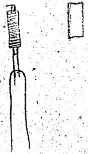
3

333

100
3
300

8)300(
37
56

37
8
296

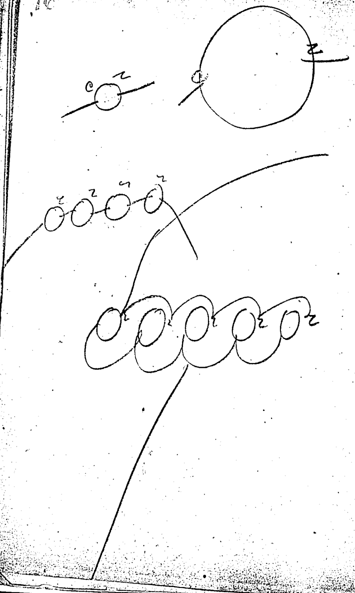


500
3
1500

3/8

16 5

3 feet



Electric Light Sept 24th 1879

Lamps

Made ~~4~~ 3/100 spirals of ~~Lime Zirconia~~

Made ~~2 — Lan & Did Ox.~~

Made ~~2 — Cerium Ox~~

Made ~~2 — Aluminum Ox~~

Made ~~2 — Magnesia~~

2 — Glucina

Made ~~2 — Titanic Ox~~

Made ~~2 — Zinc Ox~~

2 — Silica

2 — Strontia

2 — C[illegible]mium Ox

Made ~~2 — [illegible] Ox~~

2 — Molybdenum Ox

2 — Chromium Ox

2 of Barium Ox
2 of Tungsten Ox
~~2 of Sulphur~~ No good

Spool Covering Oct 6 1879

Cannot put the Sulphur
On in any Form

Zinc oxide very difficult to get
on in good covering — Can get very
thin coating on but wipes off by
hand — Made one spiral from
~~Acetate of Zinc~~ by reducing the
~~Acetate to a~~ syrup and then
baking on —

Stannous Acetate will not coat
the wire at all

Made a Zinc oxide by dipping spiral in solution of Zinc ox and water and burning ~~water~~ out

---

Made a tin oxide by mixing oxide with water and dipping spiral coated very thick

---

Made 2 Titanium oxide ~~spirals~~ one by coating from solution in water & the other by dipping

---

Chas Batchelor

84

2/6

68
80
36 0

1/2 = 4th '060

'111 - 36 times more
4
144

$\frac{1}{8} \times x = \frac{2}{16}$ 533

33

18/330
27

27½

'125
3.1
125
375
'397
27½
278
719
10.7½

6/32
5

'0625
'1875

$\frac{1}{6}$ '333
$\frac{1}{12}$ 15

'125 | 33 | '187
.33
561
561
121/6171

'1875
2
'2085

'653
'20
'13061
653
'18
5224
653
'11754

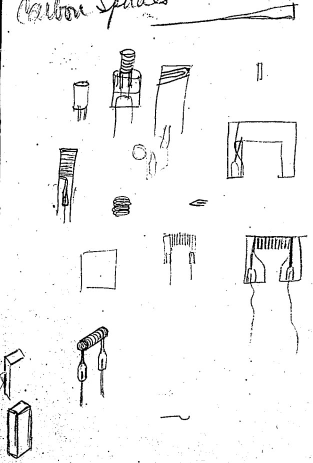
'1256

'208
'314
832
208
624
'65312

'653
'22
1306
1306
'14366

Electric Light Oct 7 1879
Chas Batchelor

Carbon Spirals



Spiral of Carbon Oct 7 1879

Mould for Carbon Spiral

Chas Batchelor

Spiral must be ·18 long

Inside diameter ·1875 or $\frac{3}{16}$

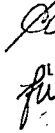
outside " ·207

Made a mould for squeezing put in some of Wallace soft carbon and squeezed it out of a hole ·02 diameter getting it out a yard long if required—

Could make more even sticks by rolling on glass plate with piece of very smooth wood.

these sticks could be rolled down to '01 and then wound in spirals. We made some and baked them at a red heat for 15 minutes in a closed tube - When taken out they were hard and solid much more so than we expected and not at all altered in shape — A spiral made of 'burnt lampblack' mixed with a little tar was even better

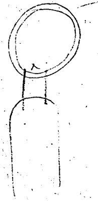
144

than the Wallace mixture —
— With a spiral having 5 inches
of wire of ·01 we can get 100 ohms
— We now made a double spiral
on brass so as ~~to wind~~ the
carbon  so similar to ~~the~~ some of the
first platina spirals we made —

92

Oct 21

TAE

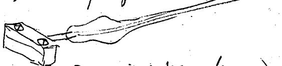


circle paper (carbonized)
x broken out

Electric Light   Oct 21st 1879   93

Carbon Spirals

Made enclosed tube for the baking of the spiral to carbonize it.



bonize it. We found that the ~~wire~~ carbon always broke just at the junction of the carbon and platina so— this we could not account for so I made a ~~straight~~ piece of carbon & fastened to a pair of wires and

put in a closed tube and heated the tube — I then found that at quite a low heat ~~at~~ yellow oil came from the carbon and ran down the wire and the carbon parted very easily just as if the had melted filling the tube with white smoke and having a yellow oily liquid on the top of centre glass which I suppose is Benzole or one of its first compounds

I now put another in a tube and baked it 1 hour at 165 F then ½ hour at 220 then 1 hour 320 when I took it out

It showed an oily liquid (yellowish green) on glass showing that the first product had gone off and that is the one that busted it before

I now heated the tube as hot as I could in the flame and I could not see any thing come off except a slight white smoke this we now blew in a bulb & made a vacuum and with 9 cells C ~~H~~ Cell gave a deflec 43° showing as Upton tested

78

Electric Light Oct 21st 1879

Carbon wire

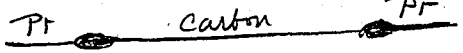
A spiral wound round a paper core no matter how thin always breaks, because it contracts so much, If the heating is done slowly this is modified but with the present proportion of Tar and Lampblack it will always break.

Clay put on a spiral to insulate the outside and prevent it from sticking together tends to crack the spiral still more ~~and~~

We now put a larger per centage of lampblack to same tar about twice as much and the

wire would still draw out at the ordinary temperature

The better way to carbonize these Carbon wires would seem to be to take the wire so: and fasten 2 platina ends in it, and



then wind in form of a spiral ~~so:~~

One of the great difficulties is to keep the spiral in position whilst you carbonize it; this might be remedied to a great extent by

using a hollow sleeve &
winding the spiral inside
with something to hold the
ends whilst they are being
fastened to the leading wires

113
140

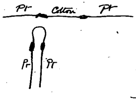
Electric Light Oct 22nd. 1879

9 am.

Carbon Spirals

No 9 Chas Batchelor

We made ~~some~~ very interesting ex-
periments on Straight ~~wires~~ carbons
made from Cotton thread so.



we took a piece of 6 cord thread No 24 which is about 13 thousandths in thickness and after fastening to Pt wires we carbonized it in a closed Chamber. we put in a bulb. and in vacuo it gave a light equal ~~to about~~ ½ candle
18 cells carbon. it had resistance of 113 ohms at starting & afterwards went up to 140 — probably due to vibration

ch

106

Electric Light Oct 22 1879 107

Carbon lamps
Carbonizing process

We made lamps in same manner

1 of — Vulcanized fibre

× 2 — Thread rubbed with tarred Lampblack

× 3 — Soft paper —

× 4 — Fish line

5 — Fine thread plaited together
6 strands —

6 — Soft paper saturated with tar

7 — Tar & Lampblack with half its bulk of finely divided lime work down to .020 — straight one 2 inch

× 8 — 200s 6 cord 8 strands —

× 9 - 20s Coats 6 cord ~~not~~ no coating of any Kind

× 10 — Cardboard —

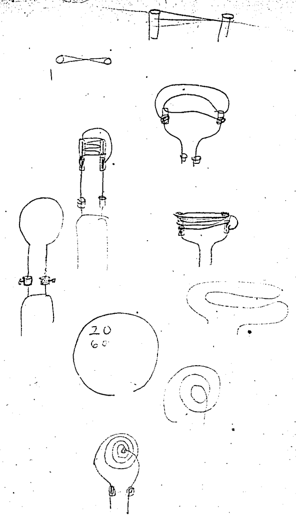
11 { Cotton soaked in tar (boiling) + put in }

m.c. mck 23/83

No 2 lamp of page 107 had on 18 cells and gave an elegant light equal to about 22 candles.

No. 9 ordinary thread Coats 6 cord #24 —
came up to 1/2 candle and was put on 18 cells battery permanently ~~for~~ at 1:30 AM —
~~#~~ Page 105 + Page 115

No. 3 came up to 1½ gas jet leading wire melted on account of conduction across mica (perhaps)
see page 115


20
60

119

100

1/2

1

was put on machine with 3rd speed 6 cells in field — It had an enormous resistance

---

No 10 Considerable resistance — equals 1 gas jet — had a small arc in —

No 9 On from 1.30 AM till 3 pm 13½ hours and was then raised to 3 gas jets for 1 hour then cracked glass & busted

---

No 11 A great many were made and boiled in tar before carbonizing but all so done broke in carbonizing —

Electric Light. Oct 27/1879 117

Carbonization

I carbonized the following substances in closed tube at red heat:-

1 Vulcanized fibre
2 Celluloid
3 Boxwood shavings
4 Cocoa nut Hair and Shell
5 Drawing paper No 1
6 Architects drawing paper
7 Drawing paper Sample 30-3.
8 " " " 3
9 Spruce shavings
10 Hickory "
11 Baywood "
12 Cedar? (Red) "
13 Rosewood
14 Fish line
15 Maple shavings
16 Tissue paper string
17 Cotton Lampwick
18 Punk.
19 Cork
20 Bagging flax

DWC
Mch
23-83

Lamps Oct 28th 1879

No

12 Eight thicknesses of 200° thread twisted and lampblacked a little—length of incandescent surface 3·5 inch ——

~~Still~~ !!! Busted by Bohm

Made new carbonizing chamber

13 8 thicknesses of 200° thread twisted & blackened a little length of surface 3·40 inch

Busted by Bohm

14 4 thicknesses of 200° thread ~~twisted~~ together & blackened with Lampblack & tar,
Broken in Carbonizing

15 3 thicknesses of 200° thread plaited together and rubbed with lampblack and tar

16 6 thicknesses of 200° thread twisted together Brought up to yellow & sealed off

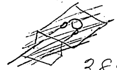
17 ditto Busted (after getting 3 gas jets out of it) about $\frac{1}{8}$ from one end ~~[illegible]~~

18. ditto

19 ditto

No 17. Had a variable resistance starting at 48 ohms and running down to

Resistance 48 — red heat
" 40.5 whitish



" 38.9 mean
" 35.0

No 20 3 inch long made of 5 strands of Clark's 300s 3 cord — This when carbonized went out of shape considerable but was intact.

21 Made of 300$^{\#}$ 3 cord
3 inch long — good after
Carbonizing

22 Burnt in Carbonizing
300$^{\#}$ 3 cord

23. 300$^{\#}$ 3 cord
Burnt in Carbonizing

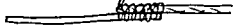
24 300$^{\#}$ 3 cord 3^{in} long
Carbonized in new chamber

25 300$^{\#}$ 3 cord 3^{in} long
Carbonized in new Chamber

26- 300^{s} 3 cord. 3 in long.
Carbonized in new chamber
came out bad shape

27. 24^{s} — 6 cord — 3 in long
no tar or lampblack on
at all — Bare thread tied
to platina supports with
200-6 cord not tarred

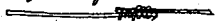
Joint of thread



Resistance 150.000 Ohms

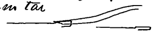
28 24 - 6 cord - 3 in long
a little tar ~~and~~ lampblack
on the joints

joint of thread



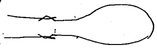
150 000 Ohms

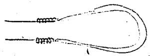
29 Card such as we mount minerals on — 3in when put in — shrunk very much in carbonizing — 250 ohms cold
joint:- on tar

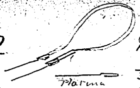


30

Card :- 3 in long
Shrunk very much in Cn
250 ohms cold

No tar on joint
joint so: 

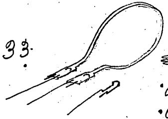
31  24s 6 cord made into lock ~~stit~~ stitch. ~~first~~ fastened to platina by winding 200s 6 cord round platina and thread

32 

Made from card
$\frac{1}{32}$ wide – 3 inch long
Burster in Carbonizing

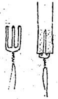
Dnc mch 23/82

---

33. 

Made from card
~~$\frac{1}{32}$ in wide~~
·043 wide
·010 thick
3·312 long –
with wide ends and the platina doubled and put through

---

34 

Three pronged round clamps

3

75

25/1.00
.04

25
3
75

.050

.040

.040
3.1
04
12
.124
3
.372

040
04
.080
20
.100
.3

.04 broade + 4 in long, would be .3 surface

Three pronged flat clamp

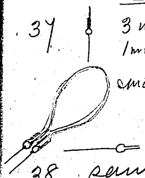
35

Flat clamp

36

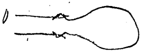
37

3 inches long Card
1mm. wide. fastened with
small clamps so:



38 same

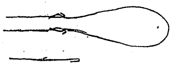
39 same

40  Made for test
but too great resistance
40.000 ohms

3" card
$\frac{1}{16}$ wide

gnc
mch
23/33

41 · 3" Cardboard
$\frac{1}{16}$ wide
Connections made so:—

 made for Show

Nov 11th 1879

Made chamber for carbonizing
and cut out pieces so:

and carbonized
a number in be-
tween cards ~~they~~
Came out excellent

slightly wavy but straight and flat on the ends

Nov. 12th 1879

In order to bring the cards out of carbonizing chamber perfectly straight we found ~~the only~~ way was to put sheets of tissue paper in between the loops (instead of cards as we had been) using and after 6 alternate layers of loops and tissue sheets to put a small piece of carbon to act as a light weight on top.

then close the whole up in
a chamber and heat very
slowly taking care not to
get too great on it until
after all the volatile matter
has gone off which will
be known after ~~all~~ it has
given over smoking—then
put in furnace and bring
to a yellow heat

Nov 12th 1879 Chas Batchelor
F. Jehl[?]

Lamp.
42  flat card
Carbonized well
and kept perfectly flat

We find ~~that~~ the brass clamp
are bad from ~~the fact that~~

the heat takes the temper
out of the brass and tend
to straighten out the prongs
eventually letting the loop drop out
~~of the~~ from between them.

We have made some of steel
wire ~~so~~ which have much more

spring

Nov 17th 1879 Chas Batchelor
[illegible]

In order to prevent the bad effect of the prongs opening, owing to the heat tending to straighten them

we make it so:—
Now if the heat tends to straighten the prongs they will press tighter on the loop.

Nov 14th 1879 Chas Batchelor

Lamp 43 Made of card cut from new model and set in new clamp steel same as above

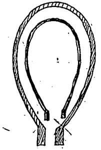
Nov 14th 1879

Chas Batchelor
F. Jehl

Lamp 44
Made from new model
with straight steel clamps

Resistance after bringing up
in vacuum

The new model that we cut the



papers from has a
surface before carboni-
zation of
thickness .43
making true radiating
surface of
After carbonization it has these
dimensions length 3.025
width .032
thickness .005

Cubured

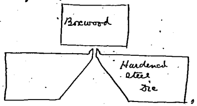
Cutica

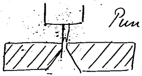
Cutacur.

[illegible] 3 Caaard 5

[St]amp Card Cutter

We must cut these loops out by punches and the following devices might do:-





Punch and die steel with [illegible] Change
Punch nipped out its ~~&~~ whole length

Nov 18th 1879
Chas Batchelor

Nov 18th 1879

Lamps

45 } Both alike and same as
46 } 43

Nov 20th 1879

~~Resistance~~
Lamps

47 same as 43 Book 85 page 210

48 same as 43 " " " "

49 " " 43 ~~Book~~ 85

50 " " 43

51 same size as 43 but made from old automatic bibilous paper ·0045 thick

52 Same as 43

53 } Made as models for patent Office
54 }

---

55 Same as 43

---

56 }
57 } Same as 43
58 }

59 }
60 }
61 } Same as 43
62 }
63 }
64 }

~~Nov 19th~~ Nov 23rd 1879
Chas Batchelor
F. Jehl [?]

65 Made out of Bibulous Chemically pure paper ·0045 thick

Nov 24th 1879

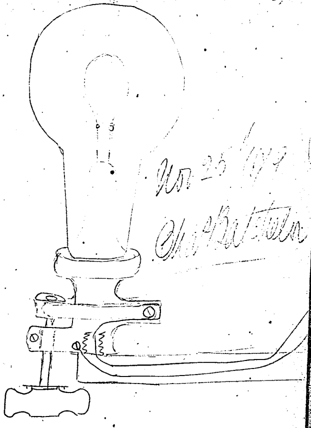
Lamps

I notice that when I make one from bibulous paper as in case of 51 and 65 they shrink much more in carbonizing than those made from cardboard like 43

66
67
68
69
70 } same as 43.

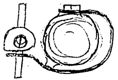
All that we have made like 43 are cut crossways out of the card

Chas. Batchelor



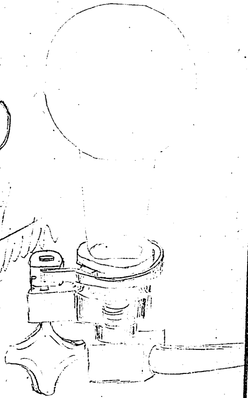
Nov 23 79

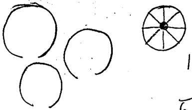
Chas Batchelor



Mar 5 1879

Chas Batchelor





1200
50
60,000

100,

1630

Portland

II

60000

Portland

365
60
21,900

150
200
30000
80

8

1200
15
6000
1200
18000

2

1200
30
46000,
30,000
30000
12000
118,000

125000
16000
141.000

14

40
5
200.

365
200
67000

75,

30

14000
28000
36500
78,500,

16.30.

60
30
1800

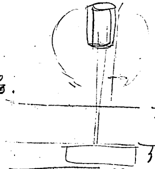
50,

25
8000
200,000.

25

30 00
16 30
13,70

365
200
73,000.



365
13
1095
365
365
4743

365
70
25,550.

25550
3000,50

10
18
6
40
5
10

12 36

1 Portland Portland

7

365
100
36500.

November 25 1879.

Put 3 Horseshoes between plasterparis first a layer of pp then a horseshoe then pp & ~~soon~~ so on smoothing down before laying paper on. then Carbon weight on top = -

Replace PlasterP by - Chalk - Caustic Lime, Caustic Magnesia, - by Plumbago - Silica, Powdered carbon.

71 Piano wire clamp with large flat platinas on
The card cut lengthways so that grain (as it were) lays that way -
Carbonized with white tissue paper (not oiled)

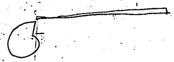
72 ditto - - - -

73 ditto - - - - -

74 Same as 43

---

75 Piano wire clamp -
Loop cut from highly calendered paper .0045 thick found on Kinney's table



Nov. 26 1879 [illegible]

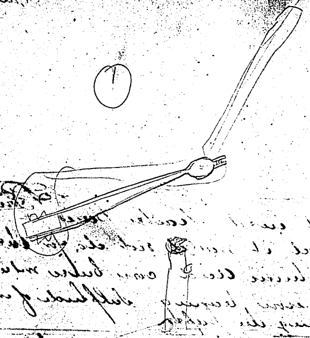
Tried carbonizing with Plumbago put 3 limestones in the cylinder and brought it up to a [illegible] heat found that the limestone came out rather [illegible] and that the plumbago adhered to the paper

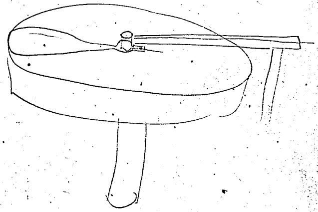
[illegible]

Next tried Plaster Paris found it would not do for the sulphuric acid combines with the iron leaving sulphide of iron spoiling the paper

Tried carbonizing with chalk — but the heat to which it was subjected formed the chalk into a solid mass spoiling the paper

Made a ball of it and used the oxide of Manganese instead of powdered carbon was not worth a [illegible]





Dynamos	30.000.
	36000
Engines	24000
Boilers	12000
Extras;	16000
Condrs.	118.000

30

1200
30
36000

150
50
7500

1200
20
24000

150
80
12000

150
200
30,000

34705

117
365
585
702
351
32705.

3000

10.

125.000.

Engs	9.
Firem	18
Stoker	10
	10
Coal	28
Oil	5
Waste	2
Water	5.
Extras	10
Rent	20

coal.

3

1

3 365
200
73000

8000

40
6
240.

365
20
7300

125.000.

365
120.

365
120
7300
365
43800

Lamps · Nov 27th 1879
Chas Batchelor

76 Same as 43

77
78 } Same as 71

79
80 } Made from Cranes parchment No 56

81
82
83 } Made from Cranes parchment No 44

snc
mch
23/82

38000 Expenses
10 000 Depreciation
48.000.

Tests of Papers and Cardboard for ash

Bristol Board A ~~very [illegible]~~ fair

" " B loaded badly

" " C fair not loaded much

P+B card 8-78-4 splits in three in flame

" " " " " 5 very heavily loaded

" " 8-78X 21 splits in ~~three~~ 4 pretty well loaded

5-79- 50 splits in two not loaded

5\79- 33 Splits in three heavily loaded (Mg)

5\79 — 43 ~~very lightly~~ not loaded

6\77- 43B not loaded at all

9\76- 47 not loaded at all

over

P. Aug B. 8-78-
very heavily loaded

P. Aus B. 8-78 — 37.
heavily loaded

P. Aug B. 9-76 — 36
fearfully heavily loaded

P. Aug B. 5-77 — 29.
Pure —

P. Aug B. 8-78 — 34
Considerably loaded

P. Aug B. 5-79 — 33
Heavily loaded Mg.

P Mg B. 8-78 — 30
heavily loaded with Mg

P Mg B. 8-79 — 29
heavily loaded with (Mg)

P Mg B. 5-77 — 28 —
not loaded

P Mg B. 6-77 — 29 #
very very pure

P Mg B 8-78 = 28 —
not loaded

P Mg B 8-~~78~~ — 27
Not loaded but slightly

P Ad B. 8-78 — 25 —
exceedingly heavily loaded

P Ad B. 8-78 — 20
heavily loaded

Lindenmeyer Sample
very heavily loaded

Francis Ad Loutrell sample
rough paper
only loaded slightly

Goodman Ad Schauk
Bottle Green Burton
heavily loaded

G + S. Satin Enamel
all comes to pieces
heavily loaded

G. Aw S. Artists Black Bristol
not loaded ×

G. Aw S. Brown Bristol
loaded heavily

G. Aw S. Kent Bristol 4 ply
loaded heavily

G. Aw S. Navy Blue Bristol
Blisters and falls all to pieces
leaves blue pigment

G. Ay S. Kent Bristol 3 ply
heavily loaded

G. Ay S. Kent Bristol 2 ply
heavily loaded

G Mo S. Victoria Tinted
Badly – loaded

G Mo S. Lenox Bristol 4 ply
3 ply
loaded 2 ply

G Mo S. Translucent Bristol
Badly loaded

G Mo S. Clothlined Blank
loaded only slightly

G Mo S Lithographers 2 Ply
Bristol Blank
loaded.

G Mo S. Thin Satin White

Tried carbonizing with caustic Magnesia — formed into a solid mass and broke the paper all up — — —

A Poirier

Next tried carbonizing with powdered carbon — failed N.G. —

A Poirier

Nov. 28th 1879

Carbonized with mica instead of paper — the horse shoe came out very smooth but broken — put two carbon plates

A Poirier

Tried mica plates without any carbon and found that they came out flat but out of shape

A Poirier

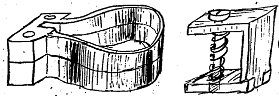
Lamps

Nov 28th 1879

84
85
86
87
88

Made from card same as 71

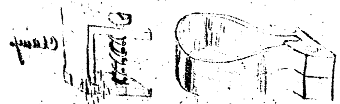
Made a new steel cutting former for loops with 4 clamps to hold it together



Clamps

This Cuts them much more even

Chas Batchelor
F. Porier
J. Seymour



Nov 28th 1879

Lamps.

89 } Made from .0010 Bristol board
90 } and cut out with the new
91 } 'former'

92
93 Same as above
94

Nov 30th 1879 –

Made 15 lamps same as above
No. 95 – 109 inc –

Dec 1st 1879

Made 15 lamp same as above
110 – 124 inc.

Fault in Lamps   Dec 4 1879

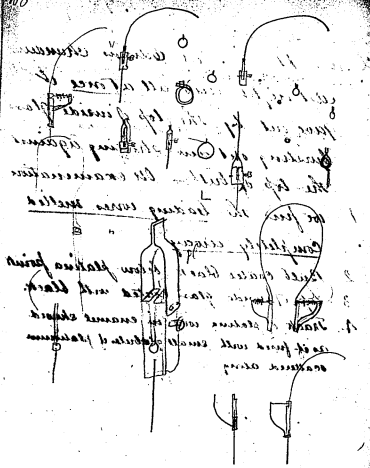
Lamp 118 was on Edisons chandelier last night and all at once it gave out by the top of inside glass bursting out and striking against the top of bulb— On examination

1 we find the leading wires melted completely away

2 Bulb coated black below platina points

3 Top of inside glass coated with black.

4 Track of platina wire in enamel showed as if fused with small globules of platinum scattered along



Fault in Lamps

Lamp No 101 after giving excellent light during exhibition last night played out by reason of the loop falling out of the clamps — loop keeping intact —

On examination I found

1 Black deposit thick below platina points and slightly all over the globe

2

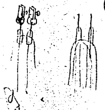
General faults

1. We notice that some of bulbs are perfectly clear after bringing up and using whilst others are covered with black – this may be from the fact that some may be better Carbonized than others and those not carbonized are brought to higher heat in Vacuo & give out more stuff that coats the glass

Chas Batchelor

Dec 4th 1879

Made 4 Lamps with new platina clamps so: also made glasses (sealed on platina wires) stick out of glass so:—



These were great improvement and are numbered

125 – 126 – 127 – 128

Chas Batchelor

8
200
1600

400
800

2
4
8
16
32

2
4
8
16
32

200
60
12000

1
2
4
8
16
32
64

1
2
4
8
16
30

6
50

25

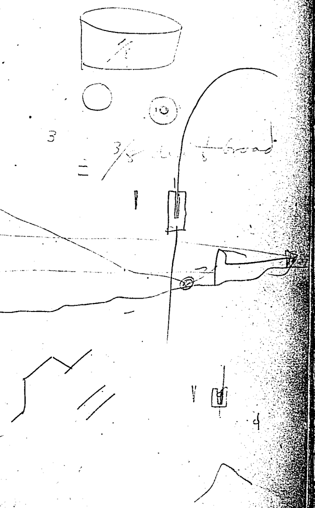
25000000000

100

600

100

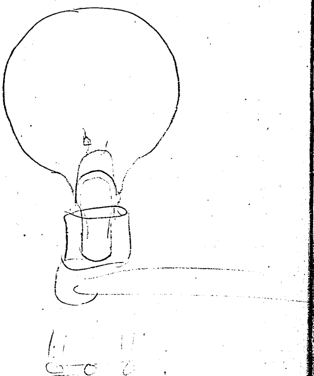
52
2
104

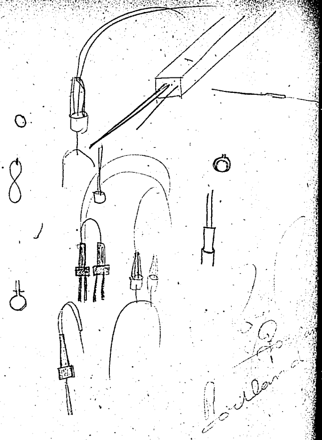


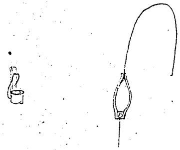
Test of E Light Dec 5th 1879

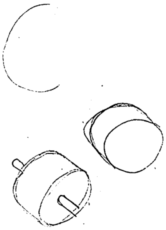
On Dec 3 we made a test at Edisons house at which Mr Fabri and party saw it - We lit 2 three light chandeliers 1 two light ditto and ran the sewing machine and hand lamp all went off perfectly with the exception that I put in one lamp and the wires projected too far and made an arc on brass underneath this did not hurt the lamps —

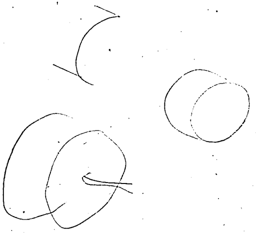
Chas Batchelor

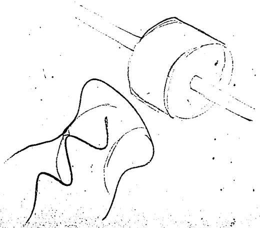












Dec. 5th 1879

Put a horseshoe in a cylinder and kept it over the gas flame for 1/2 hour with a weight of (~~[illegible]~~) 9725 m.g. had 3 jets of gas and put it over at 10.25 and put it in the fire at 11.15 and let it remain for 28 minutes until it came near melting — came out all right — but changed from 1 to 3 —

Put 3 horseshoes in same as before and they came out with the top one the largest and the bottom one the smallest — the weight being about 900 m.g. — Did not seem to be altered by the reduced weight

---

Lamps. Dec 5th 1879

Took one regular loop and marked the inside edge of it so:—

This I made a standard to pick others out of from the whole — After picking them out to size I took them carefully over under the microscope and throw away any that have flaws

We now use of course new glasses (inside) and platina Clamps

Made 4 lamps No. 129 - 130 - 131 - 132 -

Made 4 more No. 133 - 134 135 136

All these we found no good as in blowing the inside glass it is left too thick so that it cracks with heat —

Lamps. Dec 6th 1879

We now had Boehm blow the glasses inside thinner

We made 4 this way

Nos 137 - 138 - 139 - 140 -

Platina Clamp 

Chas Batchelor

Dec 8th 1879

Made 2 lamps with Carbons carbonized with weight of ~~##~~ 126 grains Troy of carbon

No. 141 an 142. 143 Chas Batchelor

Resis 141 — 295 ohms
" 142 — 300 —
143 -

J Kruesi

Dec 8th 1879

Made 1 lamps with paper carbonized (1/2 hour in muffle) with carbon weight of 400 grains

No. 146 Chas Batchelor

F. Jehl? [illegible]

Made 2. lamps with paper carbonized with weight of 250 grains.

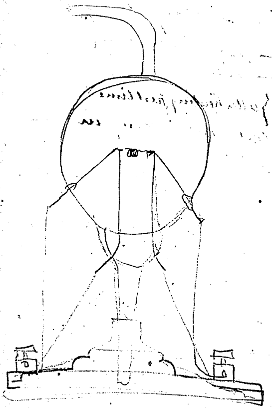
No. 144 and 145

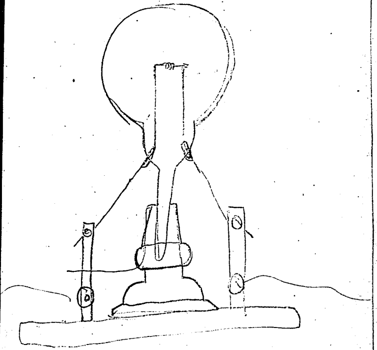
Dec 8th 1879 Chas Batchelor

Resistance of Lamps

ohms

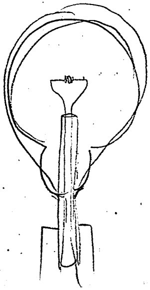
141 — 295 — 154 after heating
142 — 300 — 150
143 — 152 } after heating first time
~~144~~ ~~152~~
145 — Busted in putting in —
146 752 after heating
147
148
149
150
151
152
153
154





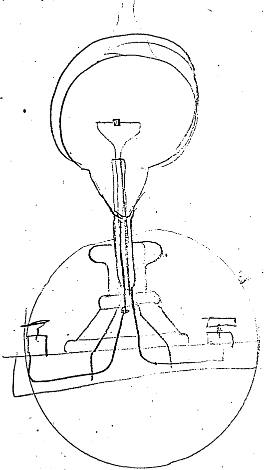
79
200
158.00

79
400
316.00



.100

79.



Lamps. Dec 8th 1879

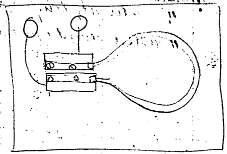
147 - Same as 141
Resistance at first 300
" after heating
" when sealed off & cold 145

---

148 Same as 141
Resistance at first 230
" after heating
" when sealed off (cold) } busted at clamp

---

149 Same as 141
Resistance at first 340
" after heating
Cold " when sealed off 150



Dec 8th 1879

Lamp.	Same as	Resistance	Res. after Sealing
150	141	245	117
151	141	275	160
152	141	295	Broke on pump.
153	141	300	132
154	141	310	122
155	141	300	126
156	141	500	157
157	141	240	199
158	141	320	139
159	141	275	153
160	141	415	145
161	141	415	147
162	141 390		
163	141 380		
164	141 245	270	132
165	141 246	255	150
166	141 250	265	157
167	141 252	250	136
168	141 250	247	147
169	141 250	265	Busted on pump.
170	141 250	265	157
171	141 250	250	142

	No of Lamp	Same as	Resistance at first	Resistance after sealing	Remarks
Dec 9th	172 —		235	135	
	173 —	Busted	by Bohn		
	174	141	260	147	
	175	141	240	135	
[illegible]th	176 —	141 250	285	167	
	177 —	141 Do	245	155	
	178 —	141 Do			
	179 —	141 Do	250 —	195	
	180 —	141 Do	250	180	
	181 —	141 Do	245	152	
	182 —	141 Do	—	—	Busted by Bochm
	183 —	141 —	245	145	
	184 —	141	240	132	
	185 —	141	275	155	
	186 —	141	235	128	
	187 —	141	240	142	
2[illegible]	188 —	141	270	149	
	189 —	"	Broken at clamps		
	190 —	" —	250	135	
	191 —	" —			
	192	"	Broken at clamps		
	193 —	141	230	134	
	194 —	141 —	—	121	
	195 —	141 —	Busted somehow —		
10th	196 —	141 —	265		
"	197 —	" —	250		
"	198 —	" —	240		
"	199 —	" —	270		
"	200 —	" —	230		

Carbonization — Dec 13th 1879

Chas Batchelor

Used plumbago in the mould round the edges but they came out 390 ohms resistance ought to be 250 —

Put three in iron mould and carbonized without previous heating but they came out 490 ohms

I think that the tarry matter must not be driven out quick but left in if possible to lock the particles together in a hard shiny mass. therefore the first heating ought to be very slowly. –

100 volts
10 ohms

$C = \frac{E}{R} = \frac{100}{10} = 10\ C$

$\frac{200}{20} = 10$

100
100
10000
44
10)440000
44.000

200
200
40.000
44
176.000
88.000

Dec 13th 1879

Carbonization

Tried a mould of two plates of Carbon from Condit and Hanson battery — First lot came out high resistance and crumply there was a great lot of brown stuff came from the Carbon probably sugar put in in moulding ——

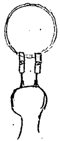
Second and third lots came out over 1200 ohms resistance

Chas Batchelor

228

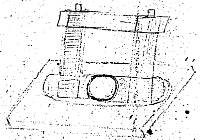
Dec 15th 1879 229

Make some lamps circular in shape so:—



Inside length 2· inches
make them such a width that they will be 100 ohms resistance —
~~leave the circle complete and let current break out piece between clamps~~ break out the piece between Clamps.

Chas Batchelor



amp.	Same as	Resistance after Carbonization	Resis^a. after sealing	Dec.	Remarks
201	141	285		15	
202	"	225		15	Busted on pumps after being heated up 5 hours
3	"	225		15	
4	"	275		"	
5	"	260		"	
6	"	240		"	
7	"	240		"	
8	"	340		"	
9	"	270		"	
210	"			"	
11	"			"	
12	"				
13	"			"	
14	"			"	
15	"			"	
16	"			16	
17	"			"	
18	"			"	
19	"			"	
220	"			"	
21	"			"	
22	"			"	
23	"			"	
24	"			"	
25	"			"	
26	"			"	
27	"			"	
28	"			"	
29					
230					

$$\begin{array}{r} 36500 \\ 35000 \\ \hline 5\text{-}1501 \end{array}$$

150,000.

10
18
35
5
1.0
1

$$\begin{array}{r} 365 \\ 90 \\ \hline 5\quad 0 \end{array}$$

$$\begin{array}{r} 365 \\ 100 \\ \hline 36,500 \end{array}$$

Dec 15th 1879

Carbonization

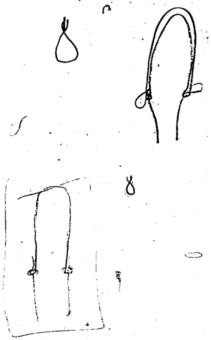
In order to get at the bottom of the fact that all do not carbonize alike in same chamber at same time we made following test:—

Cast iron chambers—

3 loops in each —

tissue sheets between each and between loops and iron and a plate of carbon of 126 grains as weight on top

over



Resistance

No	top	middle	bottom
1	207	234	217
2	240	255	210
3	212	212 -	211

No 3 had 2 sheets of paper between the iron and also between carbon this seems to make it more even —

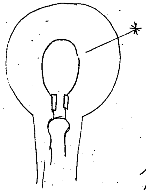
4

Carbonization :—
Points from which to draw conclusions —

1 middle one is always highest resistance
2 All lengths of times in Carb. give good ones
3 All heats gives us good ones
4

Lamps

Lamps Nos 200 and 202
had been burning about 4 hours
of Dec 16 and 1 Hour on Dec 17
when both busted as in sketch



Upton suggests
that it may be
in the focus of the
curve of glass
It does not seem to
be exactly in the
focus of the curve of
the other side of loop.
They were burning at about 5 or
6 gas jets

Chas Batchelor

240

Carbonization Dec 17th 1879

Put a carbonizing mould with loops in on gas flame 25 min — Opened it and it measured 10 000 ohms

Brought it up bright red in Muffle for 10 min — Took it out and it measured 600 ohms

Put it in again for 1 hour at same heat and took it out again 270 ohms —

Put it in for 1 more hour and after bringing it out it measured

New Lamp loop (See page 229)

Make punch punch out

2.81" circumference of inside

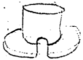
.0250 width of loop side.

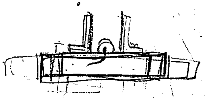
This will carbonize down to

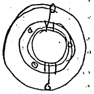
circle of 2.25 inside circum or .71 diameter

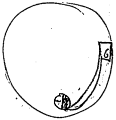
which will be ~~[illegible]~~ — same

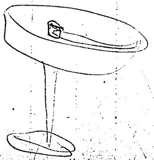
resistance as present loops











[Da]te	Lamp	Same as	Resis. at first	Res. when Sealed	Remarks
19	231	141			
	232	"			
	233	"			
	234	"			
	235	"			
	236	"			
	7	"			
	8	"			
	9	"			
	240	"			
	241	"			
	242	"			
	3	"			
	4	"			
	5	"			
	6	"			
	7	"			
	8	"			
	9	"			
	250	"			
	51	"			
	52	"			
	53	"			
	4	"			
	5	"			
	6	"			
	7	"			
	8	"			
	9	"			
	260	"			

Dec 29th 1879

Lamp. 204 Broken in inside glass — glass exceedingly thin — wires melted

---

Lamp. 260 Carbon broken — $\frac{1}{4}$ inch above regular place

" 245 Wires melted — glass thin —

---

247 Carbon busted

84
8
6 / 720
100
300

100,000

1200 40
60
00 40

5 / 1,000,000
100
200,000 2 1. 75000
40
50 75
2000
25 40.
12 25 80
2 1/2 25 160
320
25 640
2500
2 1/2 60 7 1/2
60 8
12 60

10
5 gas,
400
50
100
150
5 25 700
5 245 94
125 31
120 245
245 735
15 7595 100
8
120
3.75
15/25
12
31
12
36
37

23.
2
46.
11 1/50.
571.50.

21.
4
84.

5.

25.

125.
120
245

15.
8
120.

245
31
245
735
7595
3
22,785

Faults Dec

250 Glass busted – wires melted out –

---

201 Busted in carbon $\frac{1}{4}$ above regular place

---

259 Carbon busted in regular place

---

252 – Carbon busted in regular place

60,

6

10

50,

$$100\overline{)440000}(4400$$
400
40
400
000

40

40000 4400
10
44000

$$400\overline{)440000}(1100$$
400
400

2200,

1100
20
22000

1 400
2 200
4 100

~~245 Glass busted – Wires melted~~

227 same

150 Carbon broke at 1/4 above oxydised badly

156 Glass broke
141 " "

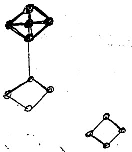
184 Carbon busted right in top

220 Carbon ~~busted~~ broke on pump.

199 Bust in Glass

223 Bust in Clamp

256



100. Société du T

100. Société Generale

Germain 50 " Du Telephones

Germaine

5000000000000

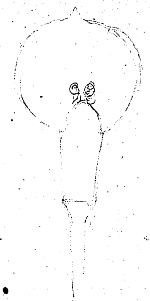
$\frac{1}{50}$

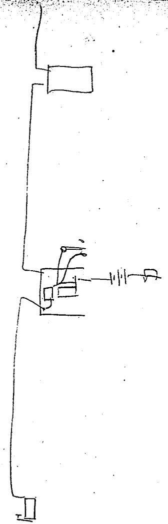
$\frac{1}{50}$

Jan 2 1880 257

No 167 I saw bust, and
Inside glass broke and in platina
clamp falling together crossed
and burnt out the 'trap' of
chandelier — Burnt ~~4~~ 8 hours

217 Burnt 4 days
Chandelier over Griffs desk
Broke $\frac{1}{4}$ inch above regular place
probably bad vacuum Edison brought this time





 lamp for 6 week
lamp[illegible] carbon tel continues that way
4 or 5 days
If [illegible] of water few hours came back
to more than original lamp
showing that you can take chalk [illegible]
has been wet some time

After [illegible] [illegible] & allow to stand [illegible]
that if they have uneven talk [illegible]
can even day if [illegible] quite dry
just scarcely [illegible] water [illegible]
[illegible] [illegible] [illegible] brush on [illegible]
[illegible] [illegible] [illegible] [illegible] [illegible]
without [illegible] body of [illegible] [illegible]
for 1 minute

Young man made an improvement?
[illegible] rubber upside down results
90 ~~telephone~~ [illegible] all set
wrong ~~[illegible]~~ — Young man got
[illegible] [illegible]

$25 \quad E = 100 \quad R = 4$

$C = \frac{}{R}$

$\frac{E}{C}$ ~~$E \times C = R = 100 \times 25$~~

$\frac{E}{R} = C = \frac{100}{4} = 25$

$C \times R = E = 25 \times 4 = 100$

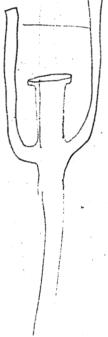
$\frac{E}{C} = R = \frac{100}{25} = 4$

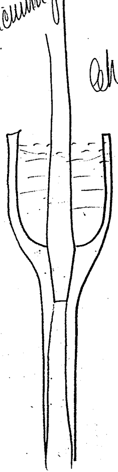
If chalks are ~~[illegible]~~ up and put
in tel. they will talk quite
loud with their own water if moist
to [illegible] will [illegible] them out
in a few minutes of course that
will not [illegible] [illegible] but in case
emergency is good

Aug 12 1879

Vacuum pumps

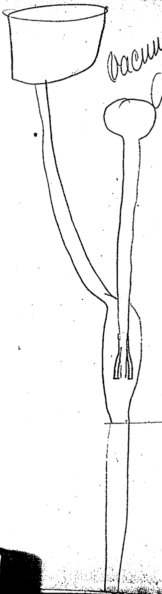
Chas Batchelor





1 13.5

Vacuum pump Aug 13 1879
Chas Batchelor



There

30 inch

Now is the winter of our ~~discontent~~

Made glorious summer by this son of
York and

There was a little

4000 = 160—
1200

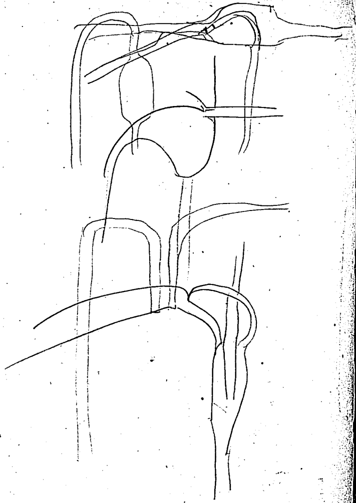
3000 - 150
1464

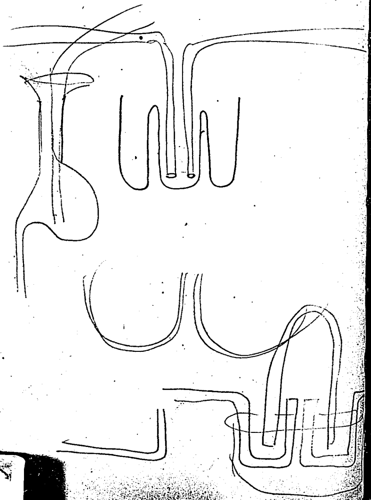
1234567890

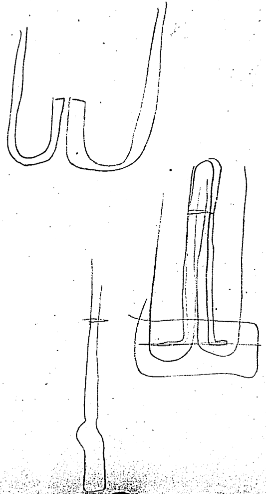
123456~~7~~8888890

145 There was a little girl

1760







Pump

Aug 13 1879

Chas Batchelor

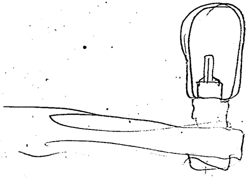
3 16 9

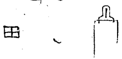
3 16

.5

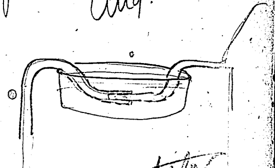
1

18





Vacuum pump Aug 13 1879



84.

Chas Batchelor

18
9.40 lamps

100.
84.4 844 / 9 of 20 per h.p.
7.94.
.8. .10

84.4.1
9
75.9.6
33.5.2
7.9.4.8

9
4
36

100 000 ft — 180.
75-000 ft) 100
20. 20.

84
4
336
66
252

9 .11

75
75
75
375
5 25
5625

5 candles each

18
1/16

2 h.p.

18. of 20 cp each.

9 of 20 cp each per h.p.

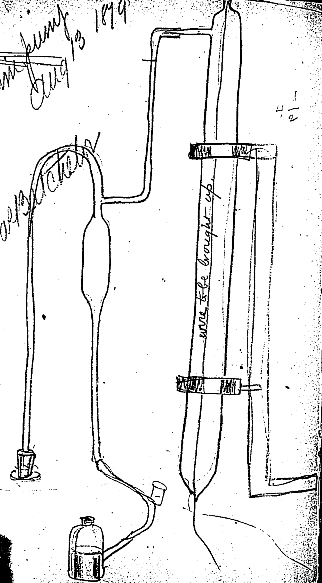
7.73 | 2.119
173) 18.00 (10.6
17 3
700

4771
2385

1.5625

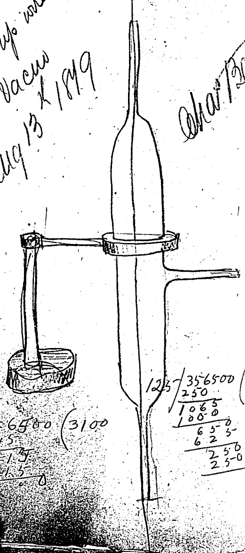
180
56
1080
900
10080

Vacuum pump
Aug 13 1879



Device for Bringing up wires for lamps in Vacuo
Aug 13th 1879

Chas Batchelor



125) 356500 (2852
250
1065
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650
625
250
250

115) 356500 (3100
345
115
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'031
48
248
124
1.488

4 ft of '010 wire has surface 1.488
practically 1½ inch

100
100
10000

44
10000
100) 440,000 (44
400
40

100. 3564
1.15 3100
1.25 2852

90
81

324
324
100) 356
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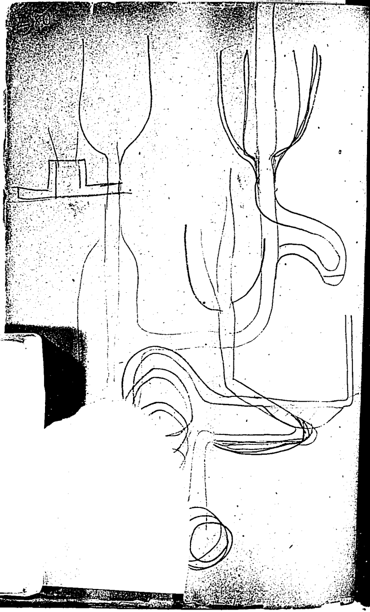
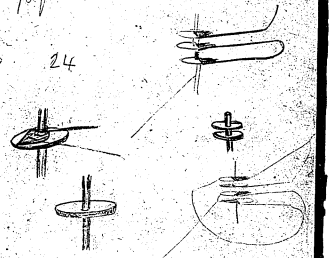


EDISON'S
TELEPHONE
24

Electric Light Regulator July 31 1879 Chas Batchelor

3 24



Menlo Park Notebook #53 [N-80-03-14], Cat. 967

This notebook covers the period March-July 1880 and contains 288 numbered pages. It is one of two journals kept by Charles P. Mott, which record daily activities at the Menlo Park laboratory (see also Menlo Park Notebook #117). There are also six pocket notebooks that were probably used to record these daily activities prior to their being entered, sometimes in expanded form, into the larger notebooks (see Pocket Notebooks). This journal begins approximately one month before the earliest extant pocket notebook. However, the last pocket notebook contains entries for the period January-March 1881, which are not found in the journals. Some of the entries in the journals are cross-referenced to the experimental notebooks. Together, these books provide a narrative record of the last active year of the Menlo Park laboratory up to the time that Edison moved to New York City.

Missing page number: 158.

N-50-03-14

1

IRIDOSMINE. IRIDOSMINE. IRIDOSMINE.

IRIDOSMINE.

B

15600
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500
300
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33.50
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IRIDOSMINE.

IRIDOSMINE.

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IRIDOSMINE.

50

5374.0

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Index to the Books by predominating subjects, most of them however contain more or less miscellaneous matter.
in use April 10. 80

Commutator		Book 80. diag. Insts. Feb 1880
Clamps	70	
Ores & Alloys	40	
Thermo	21	
Lawson Carbonization	32 ✓	
Buttons	32	
Chemical Exp	32	
Sulphides	27	
Spirals & Pumps	85	

Sunday Mch 14-1880

On Wednesday night and during the day on Thursday of last week (Mch 10 & 11) Professors Barker, Brackett, and Rowland were here, taking measurements of the candle power of the Electric Lamp and of the number per horse power, finding (I believe) very nearly twelve per horse power of sixteen candle power each, considered by them a very favorable result, Intending I believe to return some future day to ~~test~~ the energy of the generators and of the horse power expended upon the machines. after which a full record of their tests and measurements will be published, whether favorable or otherwise.

The measurement of the energy expended in the lamp was made by first weighing the lamp, next submerging

it in water. taking the temperature, Then putting on the current and noting at different periods the increase of temperature, for the space of five and in some cases Ten minutes, turning off the current and accurately weighing the water, and from this data and these figures form the basis of their calculation of the number of lamps per horse power.

During the past week John Ott has been at work on a new Relay, with electric motive power of different form and pattern than the electric engine or motive power previously applied to the relay and telephone, M.P. Adams at work on quite similar but different electric motive power or engine for chalk telephone. Livingston at work on Hot air engine experiment. Dean on mould for pressing Black Lead or Plumbago into carbon size and form, an instrument requiring

exceedingly neat, careful, and exact workmanship. Some others of the men have been and are still at work on the Large generator and today have one of the magnets wound.

I judge some important business was being transacted yesterday Mch. 13. from the fact of many telegrams being recd. and sent. presumably in relation to Edison's relay,

Today his Uncle from is here visiting, him, otherwise the day is quiet and disagreeable.

Sam. Mott stricken off the Pay Roll last night, also Breath.

Monday Mch 15-

Andrews' Telephone chalk motor N.G. good power but too noisy-
Hot air Eng Experiment tried tonight but found N.G. in its present form further experiments to be made.
Stamp mould for Plumbago burner finished and tried. found quite satisfactory but needs some little addition which is being made by Dean, tonight
New motor relay finished by Ott this evening but not tested up to ten oclock Motor runs very quietly but with low speed and power. it was discovered that by connecting the poles of the Magnets with a mass of iron or steel, that the speed was greatly increased but no increase of power- rather out of the ordinary and usual law of speed & power-
Geo Carman plating ends of carbon horse shoes with. Nickel, copper & silver; finds Nickel to require a much stronger current than other metals.

[redacted] (Note book 56 pg. 240)
[illegible]
[redacted]

Book 41 Pg. 17 &c.

Tuesday [illegible] March

[illegible] all day.
[illegible] in [illegible]
to get the [illegible] Experimental [illegible] to
since last [illegible]
Two [illegible] further [illegible] taken up
[illegible] on [illegible] but have not
[illegible] that it has been tried in
a practical way.
Mr Batchelor [illegible] in [illegible]
some finishing lamps with plumbago
[illegible], but got only three [illegible]
[illegible] [illegible] [illegible]
[illegible] are still has that
[illegible]
[illegible] will be [illegible]
[illegible] of large [illegible]
[illegible] are running all evening
the [illegible] armature of the [illegible]
[illegible] from [illegible]
[illegible] of the [illegible] boys have been
[illegible] for Photometer
[illegible] measurements and tests and have
it ready to night. [illegible] at
[illegible] in Photometer room.

Mr Upton is making this evening a
calorimeter test, having got apparatus
and implements for the purpose - but
it is quite improbable that I can be
able to get from him the results, so
to discover whether the results will
differ from those obtained by Professors
Barker, Brackett and Rowland.
[illegible] of no other experiments or
tests of interest having been made
to day -

Wednesday March 17th

[illegible] got no information from Mr Upton in regard to his last night's tests and measurements which he is continuing to night.

Mr. Batchelor still at work at pressing Plumbago. I suggested to him the prolonging and pressing of carbonized paper or card board but am informed that it cannot be pressed sufficiently to be stable, should like to see carbonized card board prolonged and mixed with Plumbago tried in the press and if of sufficient strength and tenacity I am of opinion it would make a fair carbon as it is reasonable to suppose the resistance would be sufficiently high.

[illegible] and [illegible] continue the experiments on the hot air Engine and have as I am informed

succeeded in getting from it forty ~~eight~~ one revolutions per minute quite incouraging in comparason to their first efforts.

The generator with thin (tin) discs finished and ready for the belt but not tested because of insuficient lamps to try its power.

Mr. Clarke diligently at work figuring out the illuminating power of the edge of carbon horse shoes see Note Book No. 66. pg. 223

Mr. Edison (Uncle) left here today for Philada. on his way home.

Thursday March 18.

Mr. Batchelor is this evening pressing Plumbago in thin sheets between tissue paper and then cutting out in horse shoe form and carbonizing have none out yet (10 P.M.)

All work on Hot air Engine ceased last night in consequence of Livingston having cut his hand and not on duty to day.

Mr. Upton at work on calorimeter measurements, but does not consider the system of so much accuracy as was attributed to it by Professor Rowland as the original temperature of the water as compared to the surrounding atmosphere has a great effect on the results obtained cold water being brought to the temperature of the air more quickly and easily than it can be carried above.

Mr Greene, President of Western Union Telegraph Company ~~and~~ & President of Edison Electric Light Co. have spent this afternoon here.

Friday March 19.

Mr. Edison left for New York on 11 20 train to return tonight. All Things very quiet about the Laboratory. Professors Brackett & Young with assistant Magee(?) of Princeton came on 11 20 train Made measurements of candle power, tested electrometers for accuracy and amount of copper deposited in one half hour burning. calculated horse power expended on generator, and the energy of machine. Up to present the only results I have been able to ascertain are that the armature gave but 14/100 or about one seventh of an ohm. resistance and the magnets 1.02 ohms resistance.

Their tests and measurements were conducted with great care, and their aim appearing to be, minute accuracy. At their own suggestion their report will be sent to Mr. Edison to use as he may desire.

Thomas Alarbar

E C Eugenie

Saturday March 20

Dean at work on new mould for pressing and moulding Plumbago on ends of fibres. Clark has for a day or so past devising an apparatus for measuring the cross sections of fibre, by suggestion of Mr. Edison. is also devising a balance to weigh carbon loops
see note Book No. 72 pg 242 &c
which will necessarily be an exceedingly delicate apparatus. inasmuch as a scale used in the laboratory and weighing to one half a milligram is not deemed nearly delicate enough.
Three or four Lamps were sent to day by express to Prof Barker of Penn. University.
Several Newspaper Men, (Two-a Suns & a Tribune man) have been here this evening
This might be called an off-day for this place, very few if any

interesting experiments having been tried so far as I have been able to learn. The large generator was run for heat a while tonight but did not sufficiently magnetize before stopping engine to complete the test.

Sunday Mch. 21

Dean continuing work on new moulds, but otherwise nothing doing in Shop or Laboratory.
To night is the first Sunday night since I have been here and I believe for months before I came, that the Engine has not been running and work in Laboratory proceeding the same as at other times, and it is now understood that night work for the present shall be discontinued. Mr. Batchelor's complaining of his eyes is the present inducement for making this change, which will undoubtedly prove advantageous to all who have from choice or necessity worked nights and slept and rested during the day - and a saving of considerable expense in night meals which have heretofore

cost from \$120 to \$140 per month during the winter.

Monday Mch 22.

Dean finished mould for Clamoazo ends of fibre and this evening Mr. Batchelor made two unsuccessful attempts to get the fibre out in tact. The mould however does its work very nicely and he will probably be able to get out some during tomorrow. Mr Edison sketched another design for mold for same purpose and gave to Dean to make.

Have been running large armature all day for heat test find it heats some but could not learn from Mr. Upton the number of degrees increase, not so much however I believe but what it will be able to stand. and

Reported here that on Friday last Mr. Edison in New York City disposed of his relay to Western Union Tel. Co. for $5.0000.

Profs. Upton & Jehl at work on Photometric and Calorimeter tests probably for their own edification and practice as it is entirely useless for to make any enquiries of them in regard to their investigations.

Prof. Barker here a short time in afternoon.

Wilber here and said that during last week he filed for Mr. Edison six applications for Patent (one a day). I copied applications for two weeks stay in Interference cases Edison vs Dolbear & Edison vs Dolbear vs

Tuesday Mch 23.

Clark has Ott at work on his apparatus for measuring fibres. Mr. Edison has Carman Crosby and Hipple at work on experiment of communicating sound ~~and~~ through small lead pipe ~~leading~~ one eighth inch diameter inside leading from Laboratory to Office have not yet obtained desirable results.

Quite a large party of Navy Officers (Swedes) here this evening and apparently well pleased with the lights, sights, and the courtesies shown them by Mr. Edison,

I learn from Mr Kruesi to day

that the large generator (without armature) weighs two tons and has to day been moved into the new "Station"

To days Sun gives the particulars of the sale of Edisons Motograph to the Western Union Telegraph Company.

Mr. Welbur here this evening, he and Mr. Edison at work up stairs.

Wednesday Mch 24. 80

Geo. Carman continuing experiments on lead pipe and having attached a Mica diaphragm at this end connected to battery of telephone by wire, and also connected to relay and sounder, could work them quite well from other end of pipe, in further end of Laboratory, by connecting to that end of the pipe a rubber ball and by slightly compressing it forced air sufficient to act upon the mica disc, breaking and completing the electric connection. and thereby working the relay and sounder.

Dean finished and is using tonight a tool with which he turns a bast fibre down to $\frac{15}{1000}$ and drills

therein a hole of $\frac{5}{1000}$ diameter hole drilled lengthwise of fibre an exceedingly neat and exact tool and doing remarkably fine work

Ott at work on balance devised by Clark and himself. And Clark has finished weights for same of exceedingly fine platinum wire the least being tenth of a Milligramme

He and another opened fuse today and were examining under Microscope some waste or dump of gold mine on which Mr Edison had tested his Ore Milling process and which showed plenty gold and platinum, although none could be discovered even by use of the microscope, before the process was used.

Upton and Dehl operating on an

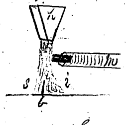
ice calorimeter this afternoon and evening - thats all -

Mr. Goren in behalf of Mr. Henderson here this after noon in relation to lamps and sockets for lamps for vessel of Oregon steam ship Navigation Co. and it was finally arranged to have the sockets made here (or furnished by Mr. Edison) the boys at work tonight cutting card board paper for carbons of lamps for the vessel.

Thursday March 25.

Mr. Edison experimenting on magnetic arrangement for separating iron or other magnetically influenced mineral from sand or other finely divided matter. a magnet is so arranged that the sand passes sufficiently near for the magnet to influence the iron from its course and separate from the silica— A bin is arranged with a long narrow aperature in the bottom through which the sand passes in a steady broad, thin stream. A short distance below is set a magnet whose ends come sufficiently near the stream of sand and attract it from the grain current thus forming two streams to act upon the iron therein but not near enough to allow the metal

to attach itself to the magnet. ~~late~~ board or other dividing petition is provided and placed so as to allow the influenced metal to pass and lodge on one side next the magnet while the uninfluenced sand will continue to fall perpendicularly and lodge on other side of petition.



h represents hopper m- magnet s silica or matter uninfluenced by magnetism i iron or other metal and "b" the petition board. the tests made with it to day would show probably ninety per cent ~~(absolute)~~ separation

Dean turned bast fibre down to $\frac{15}{1000}$ by $\frac{1}{32}$ long and drilled $\frac{5}{1000}$ hole through center lengthwise. Mr. Batchelor inserted manilla fibres through them and had the whole carbonized and got them out

ready for lamps in perfect order and naturally feels quite proud of the achievement

Clark and Garrison been for a day or two experimenting on sensative wash for paper for photographing tables. tracings &c.

Paper accounts of Lecture of Prof. Barker on Edison Elec Light (see Friday - 26 - page 36)

Have continued experiments on separating iron sand in manner described yesterday and by having the sand pass through a vessel of water thus retarding the fall and giving the magnet more time to act upon the iron and draw it from the perpendicular decent. have also rigged this evening an apparatus to experiment on dividing the sand by air blast (or winnowing) using therefore a forked glass tube having the sand pass down through one branch at same time air is being forced through the other branch, both passing out of a common mouth, the iron and heavier parts falling and lodging nearest the mouth. The boys are instructed to experiment with magnet in connection with

the winnowing apparatus
The Papers of yesterday contain accounts of Professor Barker's lecture on Edison's Light, delivered Mch. 24. in The Chapel of the Pennsylvania University and which gives to the light really more than has ever been publicly claimed for it by Menlo Park. They also contain Sawyer's general declaration that none of the statements are true that Barker is mistaken or wilfully misrepresenting and that Edison knows nothing.
Find day working to reduce the Pay Roll about $50 in addition to the saving of $30 per week for night meals

Saturday Mch 27.

Nothing new or of especial note or interest doing that I could hear of up to three o'clock when I took train for home, where I remained until Monday night returning at Midnight.
Sunday and Monday — absent

Tuesday March 30.

Experimenting on various forms of clamps and connections for fibre carbons trying Oak and various other woods for the carbon ends

Mr. Edison this evening reducing tissue paper to a pulp to test for carbons but appears to have but little faith. a Jansen suggestion imported by Mr. Upton,

Boehm preparing an apparatus for carbonizing by electricity in a vacuum,

M. C. Lavin and C. Campbell of Sanfrancisco here today - had with them some samples of Gold ore from which Mr. Edison obtained $130 worth of gold - as I am informed by "Basic"

Got for Dean, the smallest die that could be found for cutting thread

on screw but on trying it he finds it only about one half small enough in other words he will undertake to make one a trifle over one half the diameter or about 10 one thousandths - Dean turning Oak down to $\frac{12}{100}$ and drilling therein lengthwise a $\frac{6}{100}$ hole - for use on ends of manilla fibre carbons -

Messrs Upton and Edison trying by use of friction dynamometer to ascertain the horsepower being exerted on generator, but I could not learn the result -

Wednesday March 31-

Mr. Serrell here looking up papers and getting evidence ready for telephone interference Edison vs Stout.

Ott making further experiments on telephonic motors.

Dean at work on metallic parts of apparatus for carbonizing in vacuo by electricity.

Experimenting tonight on drying sand by centrifugal machine driven by electricity, took sewing machine motor from Office for the purpose find the sand to dry very quickly and rendered fit to sieve in a few minutes (say 10)

Quite a number of Mining men here today one bringing black sand tailings from Brazil but the Dr

could find no gold same man brought some substance resembling rotten stone which could be ignited with match and burn for some time emitting a smell similar to the smell of burning animal oil. also said to produce gas in large quantities.

Thursday April 1

Ott still at work on Telephonic motor experiment. Hipple and Crosby on centrifugal apparatus.
Mr. Edison tonight commenced experiment on pumps with the view of using single instead of double pump as at present also of combining or arranging a large number in small space. has on two lamps of fiber carbon. globes made tube shape

Friday April 2. 80

Mr. Edison still on pumps, boys on centrifugal dryer,
Ordered rails for electric railway - sufficient to lay track 1/2 mile long -
Dean and Boehm finished their work on apparatus for carbonizing in vacuum. the glass pump part up this evening but no connections made,

Saturday Apr. 3.

Professors Young & Brackett here making tests of the generators. and have spent the greater part of the day on them.

Mr Edison has been overhauling the old books and papers for matters in relation to telephone

Mr. Batchelor has been pulping paper by steam and subjecting it to immense pressure, do not know the intention.

I copied Preliminary Statement of T.A.E. in Interference T.A.E. vs Anders & Dolbear. Mr. Willes came in evening and took Statement with him to Washington

Find that the pressed pulp is intended for clamps or contacts for the carbons

with the conducting wires.

Sunday April. 4.

Find on my desk this morning for copying, a letter to Niven Green in relation to Patents on relays. also Patent for Separating magnetic substances from non magnetic substantially as decribed herein on March 26th Patent Numbered (application) 216.

Letter to Mr. Green refers to Patentable forms of relays which in part or in toto avoid the Page Patent and is intended to be accompanied by 16 different sketches of the manner it is accomplished by Mr. Edison's inventions

This afternoon and evening Mr. E. and Batchelor are experimenting on the method of carbonizing in vacuum but the efforts so far

have been discouraging all the carbons or attempts at carbonization, having oxidized, a regular mercury air pump has been prepared and set up and a globe shape glass vessel fitted air tight on pump, when vacuum is obtained the electrical current is completed through the mercury which is caused to ascend a double tube and form contact with iron wires, attached to the device for holding the paper or fiber encased in the globe, extending down the tubes, or double tube, The whole apparatus neat and complete but a perfect and absolute failure as a carbonizer (Note book No. 51. pgs. 1 &c.

Wm Holzer and Lawson experimenting on glass with acids, giving it the appearance of ground glass. Holzer instructed to experiment on the inner small globe with different ways of treating, with a view of preventing cracking at that point

Mr. E. now suggests 6" Hg under pressure and notes for same in Book No. 57 pg. 23 &c.

Monday April 5

Mr. Serrell here and taking testimony in interference case (Short) part of which I coppied and gave to Mr. Griffin.

Mr. Wilber here in evening and took papers which I coppied on Sunday but was unable to get Griffins signature ~~tait~~ evening. took letter book copy of Patent in Book for that purpose commencing on Page 1st & of letter to Green on last page of same book.

John Ott finished a new receiver and motor connected therewith but does not think it a success, himself. The chalk being directly on shaft of revolving armature, revolves too rapidly. and not running as

quietly as those previously made.

Moffet finished a more complete apparatus for experimenting on magnetic substances, one for dry, placed up stairs in Laboratory & one for wet, and to be used in connection with water pipes. put up on outside of Laboratory near side door.

Kinney and Mackenzie have got the use of the Western U. Tel. wires to and back from N. Y. City & Philada. and are testing the Autographic over fifty (lst from N.Y.) and one hundred and twenty (lst from Philada) miles of wire. and have had fair results. later in evening got very good results through the New York wire.

Tuesday April. 6.

Some parties from the American Machinist here today indicating the horse power of the engine expended on the Machinery and generator and the horse power expended on the generator alone.

One of the generators moved into the Laboratory for use, I believe, as a motor for driving pump for hydralic press.
Geo. Carman & McLaughlin passed here at about 9 20 this evening for California
Sam. Mott set at work on drawing of very thin wood (or vanuering) to be cut in narrow strips, bent in horse shoe or other shapes for carbonizing. for use in Lamps, do not know whether the experiment has yet been tried see Note book. 57 pages 27 &c.

I Coppied for Mr. Batchelor the Statement of result ~~to~~ ~~has~~ Mr Clark has obtained in his experiments on the carbons in telephones, an interesting and quite lengthy ~~interesting~~ paper. see Note book No. 72 pg 238.
I had some words with Mr. Carman and was by him informed that I might consider myself discharged, but replied that Mr. Edison was my employer and that I looked to him alone for such action and continued at work all day, amongst other things balancing the books.

Wednesday April 7. 80

Mr. Serrell & Edison overhauling all old telephone papers and assorting and classifying them for use in interference cases.

Mr. Batchelor having John Ott make apparatus for working wood down to proper thickness and for cutting strips therefrom to be carbonized for burners. after ten oclock in evening cut some off very neatly and believe they have struck a good thing. It yet remains to be seen what sort of carbon the products will make. Book 57 pg 31 &c.

Mr Kinney and Force jubilant over the belief that they had obtained excellent results on autographic to Phila. and return, but Mr. Edison informed them that in reality they were working only from one instrument to the other a distance of not over three feet, and

after some difficulty in making them understand why that was the case, and directing them to place a ground wire between the machines they could get nothing readable

The boys tonight testing their strength and bottom on generator in Laboratory. and Mr. E. stands at head on 143 volts. The least of them however were able to produce a fair light on lamp attached to the wires from the man impelled generator. Note Book No. 82 pg 83 &c.

Thursday April. 8. 1880

Those at work on the lamp and on carbons (Batchelor Force. Mr Edison Flammer and some of the men in Shop) greatly interested in the efforts to devise suitable means and devices for reducing woods to sufficiently small dimensions for carbonizing, and have been trying several different devices. Ott being of opinion that a very fine Keen saw will leave the wood smoother and in better shape for the carbons. Had some carbonized late in the evening but they did not turn out entirely satisfactory being some-what misshapen.

Mfg of Loops & Rings of wood Note B 51 pg 35, 41 &c.

Crosby and Hipple making some crude experiments on sand blast, using steam, and considering the inappropriate apparatus (simply sand lain on a board and forced by steam against the glass) they got very good results,

Mr. Edison, Upton & Francis making comparative tests using of Edisons Dynamometer and calorimeter,

Mr. Holzer made new style of glass cup for filling pump joints with mercury.

Friday April 9.

Still carrying on their wooden experiments on various kinds of wood and have had Martin Force out gathering what natives ~~he~~ could find.

Mr. Hornig at work on diagram of break and starter for the Electric tramway. Book 62 page 103

Clarke calculating the size of wire necessary for running about the Park to the Camps and old factory (see Note book No. 66 pages 64.68 & 70 &c) &

Lawson experimenting on extracting the gum and resinous elements from different woods to prepare them for carbonization. Put them in alcohol at two oclock P.M. Book 32, pg 109

He and Hammer also experimenting on cleaning mercury. got best results with sulphuric acid and Ferric chloride of Iron.

Blue gravel Dry Creek tunnel, Yellow gravel Dry Creek tunnel, Davis Gravel Thompson flats, Chamberlain Gravel Thompson flats, Dry Creek tailings bottom dry creek tunnel, Put in bottles in water and labelled.

Boehm made glass cyphon for experiment on the new single Sprengle principle pump. see Note Book No 68, page 7. and sketch dated ~~Mch~~ April 4. 1880.

Andrews at work on apparatus for holding spirit lamps sort of a stand. does not know the use they are to be put to.

Mr Serrell here classifying evidence for telephone interference cases

Saturday April 10.

Heating soap stone furnace devised by Holzier and Moses being tried and tested by Mr Holzier and found to work admirably both standing and retaining the heat exceedingly well.

Several of the men at work dressing & putting down sleepers for rails of electric tramway, Voorhees preparing copper connections for joints of rails, and efforts being made generally to push the road to completion as soon as possible.

Wood Loops. Dean making tools for stripping wood for loops and devising and making attachments for lathes for doing the work.

Carbonization. twelve moulds of several different kinds of wood carbonized

this A.M. and came out good carbon but somewhat misshapen. Gum and Holley coming out in best shape and most perfectly. The Resistance varied from 130 ohms (the lowest) to 180 (the highest) Note Book No 57 page 103 &c.

Pump. Dr Moses trying the new Sprengle drop pump with syphon attachment, as a whole finds it does not give results entirely satisfactory. Mr. Edison with much reason attributes the partial failure to the syphon attachment rather than to the pump itself.

Annealing oven. Andrews at work on an ~~oven~~ spirit lamp oven for annealing glass. devised by Holzier.

Sunday April 11. 80

Electric tramway. The track crew of the section of the Penn. R.R. are laying sleepers and spiking rails on the electric road and work on it being pushed as rapidly as possible in all ten men are on the work today.

Wood loop White-Holly first put in lamp about 5 o'clock this P.M. put on pump and heated up at six. one having a bad spot broke at that point before sealing off. the other remaining on all night

Monday April 12. 1880

Pump. it was noticed that in pouring the mercury in the globe reservoir. that the force carried more or less air into the globe from whence it found its way into the syphon and thence to the pump to obviate which Dr Moses had tubes made closed in bottom with apertures on sides near the bottom so as to break the fall of the mercury and distribute it in the bottom of the reservoir with less force, found it to remove the difficulty of air in the syphon but still the pump did not work as completely as desired.

Holders, the first armature with the New style of commutator brush holder finished and put in this A.M. by New style is meant  an arm attached on part of box cut for that purpose and secured from turning

 Monday April 12

by a set-screw. And upon same generator was put the first plate inscribed "Edison Electric Light Co." New York. At just 12 o'clock at night and the machine completed entirely.

Lamp. Lawson and Holzer treated thirteen lamps by their process (~~for grinding the glass of the lamps~~). The acid acts upon the surface of the glass rendering it opaque like ground glass the action was very uniform and and greatly mellows the light given out by the lamp.

Annealing oven, composed of a round base arranged to hold lamps close together an upright rod, a movable hub on same with arms of wire extending horizontally with ring on end sufficiently large to admit the small end bulb of inner tube to pass through

~~below~~ to the second bulb which rests in or upon the ring. with another lighter wire extending from the larger arm above it with spring holding device, to hold the thinner or long end of the tube from toppling about. the whole is then enclosed in a metallic sheet about ten inches in hight.

Wood ~~fibre~~ Holly lamp still on pump tonight and giving off considerable air every time it is heated up.

Wood loop Dean at work yet at twelve o'clock making tools for getting out the wood loop in the desired shape (U shaped) and to obviate the necessity of steaming and bending.

Flammer and Free making a device for steaming and bending, by means of a weight, at same time.

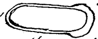
Mr. Upton making double calorimeter tests of generator. passing the current through

calorimeters one with about 189 and the other 280 lbs of water. the first test that has been made in that manner Book 82 pg. 137

Automatic, Force and Kinney are Wright using the W.U. wires for experiments and tests of the Automatic telegraph through New York and get very good results

April 13. 1880

Pump. Boehm making drop pump after sketch and plan of Mr. Upton. Note Book No. 63. pg 98.

Wood milling. Dean finished and is using the Lathe attachment for cutting wood out in required shape whereby the steaming and bending is dispensed with, he uses a steel former  Oval shaped in which travels the end of a solid steel rod and guides the revolving ~~cutting~~ cutting knife ~~the~~ to cut just the form and required thickness without danger of ~~c~~cutting where not desired. Book 57. page 155

Pyrites. Lawson commenced a series of experiments with the view of obtaining gold and other metals from Pyrites tailings

Motor. The generator set up in the Laboratory was run as a motor and tested with Prony dynamometer, which showed power of 68.100 ft pounds Book No. 59

Calorimeter. double calorimeter test very carefully made Howell and Mott assisting Mr. Upton. Book No 82. pg 161.

Copper conductor. Clarke's calculation of the size and weight of conductors necessary to supply electric current to the lamps being put out about the park and to the old factory for motor purposes, finished and as one of the results he finds that 6.3 tons of conductors will be necessary map and results given to Mr. Kruesi. Note Books No 66. pgs 64. 68. 70 &c. & 82. pg 105

Length total 27,600 ft Kruesi
Book 56 page 54 &c

Magnetic Separator. Crosby & Hipple reversed the magnets for or rather turned them one above the other for separating

Magnetic from Non magnetic material and got excellent results, much better than they got with the magnets side by side.

Enealing oven Holzer trying enealing oven and seems satisfied with its working entirely successfully.

Wood carbon white holly still on pump giving an excellent light.

April 14

Interference Mr. Edison and Batchelor with several of the boys hunting up from amongst the archives, all telephonic apparatus they can find and using such as are appertinant to the Interference case Short & Edison evidence in which is being again taken.

Wood carbon lamp of white holly broke in glass on the pump about eleven oclock this A. M.

Wood loop of proper shape gotten off the machine to day, quite a number having been cut by Wm Wright. The machine was then stopped to arrange it to run 7000 revolutions per minute. and Dean making new cutter for it.

Steam Ship of Oregon Steam Navigation co. it is learned by letter will leave Chester for New York on the 17th April And work on the generators in Shop is being pushed to have them ready for use therein.

Wire armature machine in Laboratory run as motor, and ~~made~~ its own momentum carried it 148 revolutions after armature was opened. 243 Rev. field off and armature opened, 161 field on brushes off. Machine now in use .037 plate made under same trials 336 Rev. field off brushes and armature on, 295 Rev field and brushes on. 277 & 269. field and brushes on,

Thin disc new machine with field weak from reversing made 845 Rev. after bringing up field, 476 & 465. with field and armature off. 759 Revolutions.

Pump. Dr Moses took down the cyphon pump and had air trap attached and made exceedingly like the regular Springle.

April 15-80

Hydraulic Pump delivered on stoop of Laboratory this morning.

Tests of the current of main wires in Laboratory made by Mr. Upton this morning. with meter and Electric Dynamometer. Book 82. page 175 &c.

Also tested wire generator in Laboratory as motor with wooden Prony Dynamometer. Book 59. page 207 and Book 82 page 185.

Boehm at work on new pump sketched on page 25 Book 68.

Short evidence being continued all day.

Magnetic separator. Crosby and Hipple experimenting on ~~sand~~ magnetic separator trying as many as five magnets arranged one above the other find two magnets to give practically as good results as have been yet obtained. through hopper now in use they run 25 lbs per minute. and separate it very completely

New form for cutting card board loops made somewhat wider at ends & heel finished and in use to day by Van Cleve. from which he carbonized thirty-nine carbons

Loop cutter sketched and described by Mr. Batchelor in Book No. 57 page 75 directed to be made by Dean.

Frictional resistance of Belts and pulleys of Edison Dynamometer as now in use in Generator room requested by Mr. Edison to be calculated by Mr. Clarke Book No 72 page 68 &c.

Brackett & Young report on comparison between Prony and Edison Dynamometers & Efficiency of Faradaic Machine, being carefully revised and corrected by Clarke first test of 10 minutes. Prony Registered 612 460 ft lbs Edison 547 666 ft lbs. by Bracketts reading 690 880 ft lbs. in this last ~~reading~~ Prony registered 88.6 per cent of work registered by Edison Dynamometer which was driving it.

Second comparison. 4 minute test. Prony registered 310.680 ft lbs and Edison regst. 333 360 ft. lbs. Prony indicates 93.2 per cent of work indicated by Edison

Faradic test 13m 50sec Mean Dynamometer gave 994.6 Mean speed of main shaft 172 Rev. Energy expended on driving armature 2839550 ft. lbs. and on field of force 19634 ft lbs Total energy realized 2416147. Available 2234845 Total efficiency 84.5 per cent available 78.2 per cent

second test of Generator 9 minutes gave same per ct. of efficiency.

Street lamps nine hogsheads of large Globes for Street lamps were received to day.

Unbent loop. Three moulds of natural cut loops carbonized today

Second generator for Columbia finished up and running to night.

Friday April 16

Carbons Three moulds of natural cut loops ~~taken~~ out and Thirty card board horse shoe cut by new form broader at heel, taken out this A.M. Book 57 page 115.

New Receiver the late form made by Ott

 had new chalk put in it this A.M.

Sluice box sketched and Hipple and Crosby requested to build it. to be experimented on in connection with the magnetic separator

Pump experiments. Upton and Jehl put up induction coil and condenser in dark room to be used in connection with experiments on pumps now being conducted by them. Dr Moses continuing pump experiments up stairs

using scales for weighing mercury and battery and alarm in connection therewith.

Electric tramway men at work on the trussling and Kruesi. Honig & Ott devising lever attachment to reverse the magnets and brushes and control the movements of the car motor.

Armature of .034 disc or plate that has been in use for some time, was taken out by Cunningham and found to be considerably out of balance ~~which~~ had undoubtedly been the cause of that machine running with more or less of a thumping jar, and causing considerable more wear in the journals than would result from one perfectly balanced. After balancing and replacing it was found to run smoothly and free of any jar.

Arm and lever attachment sketched and suggested by Mr. Edison last night is being gotten up by Dean. The purpose of which is to act as a guide for cutting the wooden loops
Book No 57 page 71 &c.

Shipped Weston electro dynamo machine to A. Bergmann 100 Wooster St N.Y.

Wood experiment. Martin Force is plaining holly down to .02 in. thick to be cut in loops by same method and form used in cutting card board.

Electric Governor. Ott finished and polished up the electric governor so that at 260 revolutions it acts very promptly and sensatively and they found that at 280 revolutions it exerted a force of ~~five~~ pounds on spring scales. I do not consider the spring balances will properly show the force exerted from the fact that the hook end has to travel through too much space to show small differences on the dial whereas

whereas a scale (platform) would act through but little space and might show quite differently the pounds of force exerted by the governor.

By dispatch from F. McLaughlin date 16. April lying on desk I see that he says he has shipped tailings from Tyson Goldron.

Shaw Interference evidence taking continued to day.

April 17

Columbia. Two Faradic Machines complete. Nos. 11 & 12 Shipped to day in care Morgan Iron Works foot 9th St New York for Steamer Columbia.

Press. Partition between Old Office and Laboratory part of frame building taken out preparatory to setting up the hydraulic press.

Generator test Mr Upton made a test of the .03 K disc generator, with two cells, Daniels & Fullers as field of force, getting 25 volts, Book 82 pg 201 Also tested wooden loop lamp No. 1029 Book No. 82 page 204 &c.

Frictional resistance of belts and pulleys. Mr. Clark finished ~~calc~~ theoretical calculation of the frictional resistance of the belts and pulleys of Edison Dynamometer total frictional resistance

20059 ft. lbs Book No 72 page 68 &c. he is now preparing to make a practical test to demonstrate the accuracy of the theories on which he based his calculations.

Reverse switch. for electrical tramway sketched and plan given to Ott for him to make ~~the instrument~~ patterns for castings

Reporters Two french gentlemen said to be reporters here this P.M. and shown through the works by Mr. Upton.

Glass. Man here with samples and extolling the merits of a malleable glass.

Wood horse shoe, Vanflere cut from the .02 holly wood prepared by Force, a regular horse shoe loop in new frame, brought it out entire.

April. 18.

Electric tramway. Three men straightening and grading track. Three laying and spiking rails. and three at work on trussling and other parts of the road. in all nine men on the work.

Pump Francis had Holzer make pump after his design. which is very simple, free of stop cocks. takes but little room, and comparatively little mercury. tried in evening and pump vacuum up to one half of guage tube obtained in a little over an hour. he had also made a rubber stopper cup or socket in which to make the lamp connection without the necessity of using ground glass stoppers.

The regular pump men Dreats. Hammer. and Herig. absent and C.P. Mott running the pumps.

Bracket, designed for Steamer Columbia sketched by Mr. Kruesi is being made by Mr. Andrews. Book 80 pge 176 &c.

Americal Machinist report being revised and corrected by Mr. Clark. Book 72 pg 99 &c

Ore and tailings being crushed and prepared for Mr. Edison & Dr. Hide

April 19.

Wood loops Van Cleve cutting horse shoe loops from .02" holly milled or planed down by Dean put three in form at one time and got out two after carbonization in good shape and appearance.
Mr. Batchelor making careful calculation, and sketch for new wood milling machine and has Dean at work on it.

Pumps. Frances put one wooden loop lamp on his pump in Dark room and got vacuum and heated up in two hours.
Dr. Moses with two paper loop lamps got good vacuum in five hours but had not heated. from these first efforts it would be dificult to say which of the pumps were best ~~for~~ and quickest for getting vacuum. but the pump in use by Frances is

much the simpler, cheaper, and occupies less room. Boehm making a new pump slighty different from either just mentioned sketch Book 68 page 39.

Lamps for Columbia were measured for resistance and photometric value. put into stands and gotten ready for packing. It was noticable, that the loops cut after the new wide heeled form did not generally give as many candles as the old style loops. Bk 82. pge. 209
Lamp plain [illegible] gave 25 c. gave 23 after heating
[illegible] gave 7½ [illegible]
Columbia. Faradic Machines Nos. 13 & 14. for Steamer Columbia finished up and tested. 13 proving O.K. but No. 14. gave no current and the armature was taken out by Cunningham and found to have a bad cross. which he is at work in remedying.

Meter, Lawson is preparing for a practical test and application of electric meter on the line in Labratory.

Ores and tailings Mr. Edison and Dr Hyde assisted by Crosby are experimenting and testing ores and tailings, quite a quantity of which have lately been received.

Globe mould. Holzer and Hornig devising and the latter sketching form of mould in which to blow the larger or outer globes for the electric lamps.

Hydraulic press. A man is here cleaning up and putting together the hydraulic press lately received.

Columbia; Faradic Machines 13 & 14 Shipped to Steamer Columbia care Morgan Iron works foot East 9th St. Mr. Upton went to New York this A.M. carrying with him a couple lamps for the steamer[1] to see whether the wires and connections were properly up and made and ready for the reception of lamps &c. On his return he brought one of the large opaque globes in which it is proposed to place the lamps in steamer. The armature of No. 14 weighed 212 pounds.

1 to test the wires, See Book 82. page 217 & 217 and to see whether things were

Electric tramway. Ayers drawing more rails for same, and Moffett & Truman ~~commenced~~ work on Station, 14 by 18 feet.

Stay pins are being put in all the Magnets of the Faradic machines by ~~Bradley~~ Logan. The pins are put down through the thinner inside part of the circle in which the armature revolves

dotted lines represent the stay pins

Cam feed Automatic Machine for cutting wood loops on which Batchelor and Dean have been at work for a day or so, finished and tried but found necessary to make some little alteration in the cams Mr. Edison made sketch, of the completed machine, which is attached hereto.

Air Blast Find on Mr. Kruesi's desk a sketch by Mr. Edison of the following, all on one sheet, which I dated April 20.80 and signed as witness. Blast for experimenting on separating sand. & Pump or
Pump apparatus for exhausting the air from Carbons. Wood block milled preparatory to sawing or cutting off the loops. And an Apparatus
Arc Lamp. which I judge to be an arc lamp with electric engine attachment for revolving the carbon.

which Crosby and Hipple are experimenting on by order of Mr. Edison, obtaining their blast by hydraulic pressure.

Meter test Lawson & Mott run wires from two Daniells cells in Balance room to glass house, thence to engine room thence to room now used for telephones, thence return to Balance room. for Meter test purposes, they having placed in the line four Voltameters one in each of the rooms mentioned.

Pump. Dr Moses in his pump experiments has ascertained that it is necessary to pass 250 pounds of Mercury through his pump in order to obtain a pump vacuum.

Flint glass tried by Holzer for the inner lamp tubes it remains to be seen how much the percentage of breakage will be reduced by the use of the flint glass rather than the common glass heretofore used.

Car Couplings Ott making patterns for
castings for couplings for cars of electric
tramway

American Machinist report. Mr. Clarke
finished letter on article in reply to
report made by American Machinist
No 72- page 99 to 137-

Armature core. Book No. 79 page 233

Mr. Kruesi has made sketch of armature core for Machines 15- to No. 21. inclusive, in which he reduces the diameter at the ends of the core where the wires are tied so that after the canvass coverings are put on the diameter will not exceed the central diameter of the armature 

Opaque lamps. Photometric test of acid treated lamps made, results in one case face. 9½ candles side or edge 5½ candles- in another, face 17 candles & edge 9½ candles, Thus edge giving 56% of face. This shows a less difference between face and edge than is usually obtained from the clear or plain glass lamps

Book No. 82 page 215

Street Lamps. with plough and shovels the ditches, for conductors to the Park. Street Lamps were commenced today; first passing through a couple times with plough and then cleaning them out by hand.

Meter. The electric meter placed by Lawson in the Balance room was found to have disconnected by the copper strip leading from the wire to the sheet, having eaten off at the surface of the liquid solution.

Pump consisting of but one tube intended to answer the double purpose of the Sprengle drop and guage. is being made by Boehm after sketch in Book No 68 page 45

Safety Clutch. Mr. Upton is experimenting on lead wire for use as safety clutches on Steamer Columbia also on neat and convenient holder or concealer for the same.

Yesterday and to day Mr. Clarke has been in Newark collecting data on Steam and engines and examining into the merits of quick motion engines.

Chloroform Mr. Edison states as a fact much to the surprize of. Messrs Clarke Upton and others, that Chloroform would not burn but on the contrary would extinguish fire.

Wilber here during the afternoon.

April 22

Flint glass. On April 20 Holzer sealed platinum iridium wires in inner tubes of flint glass, ten in number, which were examined to day by Flammer and pronounced entirely free of cracks, and the best glass yet used for that purpose.

Small Dynamo. Mr. Kruesi made sketch last evening for dynamo arms to be 18 inches long by 3½ diameter & 5⅞ in armature. patterns for which are being made by Ott.

Platina wire lamp made for experiment by request of Mr. Upton. which gave about 1/8 candle power before vacuum on 5 Daniell cells, but was melted down by Mr. Edison on pump before the power in vacuum was tested

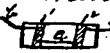
Pump. The single tube pump made by Boehm yesterday. was started by Dr. Moses and he has succeeded in getting a good pump vacuum in 17 minutes and the pump appears to work quite satisfactorily. Francis also at work with his pump but so far as known has not timed it or obtained any data as to its merits.

Electric Locomotive. Breath making Patent Office drawings of the various separate parts of electric locomotive and the same as a whole. from sketches by Mr. Hornig.

Unfinished

Motor. The generator previously placed in the Laboratory was run to day as a motor and found to heat in the journals to a very appreciable extent. I think the test was made to ascertain whether the journal heating was entirely attributable to the machines generating electricity or whether it was partly

due to friction and belt-strain.

Safety clutch. Mr. Upton devised and had Andrews making safety clutch, concealed in box shaped device made of wood, Vulcanized paper, or other non-conducting material practically non-combustible or such as would burn only at much higher temperature than that reached by the melting or burning off of the clutch.  Two metalic conducting straps or bands 1.1. pass across the box, with main or leading wires b.b. attached either by screw pressure or soldering thereto. and clutch wire, a. composed of lead or lead and zinc or other conducting metal easily melted. connected to the straps by screw pressure. The whole forming a neat trap. designed for use on the lamps of Steamer Columbia. but applicable wherever a safety clutch is desired.

Blast Pipe. Crosby attached a two inch iron pipe to the blast box or trough leading to the furnace. carried same up into second floor of Laboratory. for experiments on sand separation; but so far as tried tonight. did not give good results.

Prof. Rowland's demonstration of the power of the carbon loop of Edison Electric light has been today compared by Mr. Clarke with his method of finding the same. and finds that although their methods and formula differ. they get same results through their different channels. See Book No. 72 pg 188

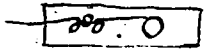
High Speed. Mr. Porter, Manufacturer of high speed engines, of Newark, here this evening. and by demonstrations of his thorough knowledge of the subject, still further confirmed Mr. Edison's belief in high speeds.

Dynamometer. The pressure of steam in the boilers and engine was reduced down to 10 pounds and steam taken in full length of stroke to see what effect it would have on the steadiness of the engine and on the Edison Dynamometer, but the difference if any was not appreciable.

Telephones. Several boxes of telephones packed and shipped to day.

Columbia. Mr. Upton and Cunningham went to New York, carrying with them some of the lamps and lighter parts of generators, to set up the dynamos and fit up the Columbia.

Apparatus for playing out the conductors for Park Street Lamps. composed of three wheels and a reel arranged on plank secured to wheelbarrow, intended to straighten and stretch the wire while being run off.



Telephone Receivers. Andrews fitting up telephone receivers air tight, by putting packing around the chalk arm or cylinder and in other ways, that they may resist the action of the atmosphere, particularly in

hot and dry climates, where the tendency of the chalk is to dry out quickly.

Pump. Boehm made at request of Dr. Mau a double tubed pump (one tube within another and larger one) arranged ~~with~~ for lamps on bottom and dryer at top where the lamps are usually placed. Book 68 page 51. He also made according to his own idea a single tube pump quite similar to the one experimented on by Mau Book 68 page 53.

Dynamo. Mr. Kruesi made sketch of Dynamo, Book 56 page 67, arranged for being secured on floor or base with one arm or magnet above the other, parallel therewith. a good device for generators for vessels or cars. or where any jar or unsteadiness might be encountered.

Tramway Station Mr. Hornig made design and sketch for dynamo station especially adapted for electrical tramways, and to control the movements of trains &c. from one point. Also sketch and device of Annealing machine for glass House.

Conductor boxes, being treated with a thick coating of gas tar, to enable them better to reject moisture and as a preventative against decay.

April 24

Columbia Upton and Cunningham in New York again on Columbia And got in the evening two of the generators running, but not early enough to test them any more than to connect one lamp to them at the machine.

Pump by Francis again up and running with lamp on. and got vacuum in two hours. He had attached a device for flooding and removing the mercury from the lamp cup or holder, made with small piece glass tubing attached on side of cup about one third down from top, to which is attached a short piece rubber tubing running and attached to a small reservoir, bottle or other receptacle. by the raising or lowering of which the mercury is forced in or drawn out of the cup. the rubber

cork or stopper in the cup is cut sloping so as to deposit the mercury on the low side at the point of connection between cup and tube.

Hydraulic Press. pump belts were put on Connecting pump with dynamo motor in Laboratory and run it for some time not however doing any work with the pump.

Journal. in which to keep these records and diary received to day and some of the preliminary work done in same

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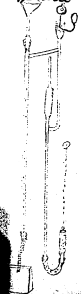
Journal. in which to keep these records and diary received to day and some of the preliminary work done in same.

April 25.

Pumps. Holzer made ~~six~~ additional pumps of same pattern as one in use in dark room by Francis. with new cup flooding device. and put on frames. with long slots in bottom and wooden slide fitted therein moveable up and down and to which is attached the, tube receptacle of the guage mercury.



April 26

Absentees. Mr. Edison and Clarke in Newark in fullfilment of appointment made with Mr. Porter on April 22d. Kruesi. Upton, Force & Cunningham in New York on the Columbia. and tried the generators and lamps. by loosing control of the engine The armatures were run at a very high speed. judged to be 1600 or 1700 Rev. per Minute. and one of the armatures was damaged by a cross so that they brought it with them in evening to have it overhauled and fixed. they also brought some of the lamps which were both too low and to high resistance.

Annealing machine devised by Hornig is to day being made Andrus.

Pump Boehm started pump in Glass house and claimed vacuum in very short time, with no lamps on.

(Insert Autographic from pg. 115 - date 28.)

Tuesday April 27-80

Water Pipe leading from Pond had become so filled up and dirty that Mr. Hood attached water pipes and is forcing water back through it carrying out quantities of mud & dirt.

Cleaning Mercury Dr Moses is experimenting on some mercury that by accident had got fouled with zinc. he had made by Boehm a reservoir in which he put the mercury and covered it with water. and by an attachment on principle of Sprengler pump worked however by water. he kept the mercury agitated by the air seeking its way through it to supply the place of that taken out by the pump. he afterwards heated it and evaporated the water, then kept it agitated by shaking after which it was treated with

acids, he had not finished the cleansing up to evening but had the mercury in much better condition than before.

Hydraulic Press. Pipe connections of Pump and Hydraulic Press completed and Pump working by Dynamo, electric Motor in Laboratory- with good field on she pumped against a pressure of 1000 as indicated by the Hydraulic pressure guage. being, I believe, all the pressure required of the air chamber, and all the power required of the pump motor.

Columbia Upton Force and Cunningham still at work on Columbia, during the afternoon and evening a reception is being given on board of her and all the people here who were fortunate enough to receive invitation cards are down. Mr & Mrs Edison going down on 6 30 a.m. train

Armature. The first one wound by Lewis Tweed was finished by him today. he also renewed the injured wire of the one crossed at the Columbia. One of the armatures finished some time since but not used. had to have some overhauling by Andrews in consequence of shrinkage and whaping of the Vulcanized fibre.

Ores from High Mountain Lode sent by J. Brother are being tested by Dr. Haid.

Locomotive Magnets- the magnets for electric tramway engine wound with ten layers of .049 covered copper wire. and put together- one above the other.

track for electric tramway finished to and around the first bend at first trussel work.

Pump. Francis claims good pump vacuum on his pumps, in six minutes.

April 28. 1880

Locomotive. Magnets of Locomotive for electric tramway wound with ten layers of .049 wire, were charged and their strength tried. The poles at the base were connected by a block of iron such as used on top of generators and adhered to the magnets so tenaciously that it required the full power of Mr. Kruesi to separate one end of the block from the magnet by the use of a short purchase bar, a force calculated by Mr. Honig to be equal to 6400 pounds.

Hydraulic Press. The electric motor worked the pump of hydraulic press against pressure gauge of 1500. paper was tried between the steel dies previously used on press up stairs and by a pressure, of indicated by Press gauge, of 4 tons. reduced paper from

.009 to .004 and compressed the paper in the steel. A piece of white Holy one inch thick by 3 inches square and by an indicated pressure of 2½ tons was reduced to 5/16 in in thickness and almost as solid and hard as bone.

Frictional resistance. In furtherance of Mr. Edison's desire to learn the actual frictional loss in belts and pulleys, journals &c. Mr. Clarke is having made a calorimeter to measure the energy lost in journals of the armatures.

Lamp protectors. Several of the lamps on the Columbia having been broken by jars from pounding overhead. John Ott to day made three spiral springs by which lamp stand may be attached to ceiling or any structure overhead and it

was found that severe pounding would not jar the lamp sufficiently to break the carbons.

Autographic. Last Monday Night Mr. Kinney got the New York and Phila wires connected so as to have the full circuit of about 175 miles and got very good and encouraging results on the Autographic.

Conductor boxes. The wooden boxes in which to run the conductors to the street lamps &c. are being laid down.

April 29.

Wood loop. cut from the thin walled Holly milled by Force and cut after manner and in same former used for card board, carbonized by Van Cleve were measured and put in lamps ready for pump resistance 125 and 194 ohms.

Pump. Mr. Upton finds the large tubed pump in use in dark room to run from 12 to 13 lbs of Mercury per minute. and comparing the small gauge used thereon with those used on pumps up stairs finds them to compare very favorably and equally sensitive ~~with~~ to them.

Dr. Moses put up a double Sprengler or combination pump, but has not yet gave it a very thorough test.

Hammer attached four lamps to one pump and noted the time required to seal off and was ready to do so in five hours. a very good showing inasmuch as it frequently takes that time to get vacuum on two lamps. He has also been burning for several days a lamp with low vacuum to test the relative value of medium with ~~and~~ nearer perfect vacuum. so far the lower vacuum shows equally as well as the higher.

Cleaning Mercury: Dr. Moses has been continuing experiments on cleaning mercury. particularly in removing zinc, and had arranged, a pipe about two feet long and two inches diameter with a smaller pipe attached at right angles. the larger pipe

was secured to the large lathe, to revolve endwise while the small pipe extended out ~~long~~ parallel to the bed of lathe. the mercury which was placed in the large pipe and secured with good stoppers was kept in constant agitation by ~~the lathe~~, being forced from one to the other end of pipe by the action of the lathe. could not learn the effect on the mercury.

Wood Milling Mr. Batchelor and Dean who have been at work for several days on getting up cams and perfecting machine for milling wood loops. got new cams in tonight and got much better results than by their earlier effort. and by very slight changes they will be able to test the utility of the machine for the purpose intended.

Conductor Boxes Ayers All day drawing from Depot the boxes for conductors. about four miles of which are required.

April 30. 1880

HOLLY

HOLLY (L.B. 3/31/80)

White Holy one of the white holy Carbons loops (regular form) put in lamp by Flammer was exhausted on pump in dark room. gives a very nice light but the loop leans considerably

Field Dynamo. John Ott making patterns for small dynamo ~~to be~~ that may be used for field in case where but few generators are necessary. such as for Steamers, factories, &c.

Brush holders. Cunningham making patterns for right and left commutator ~~brushes~~ holders.

Lamp mould. The cast mould in which to blow the larger bulbs or globes of the electric lamp. finished up by Bradley and is being tried and experimented on by Holzer. has not yet proved as successful as desired.

Columbia. Several styles of device for relieving the lamps of sudden jars have been made and tried. using springs of various number, sizes, and ways of attaching them. but do not find springs as desirable as thick heavy soft felt. which is being used in several forms. and giving the best results.

Andrus is making switch board for the steamer,

Tramway The rails of electric tramway are spiked down as far as the ties will permit of. between one and two hundred ties being still necessary to lay all the rails on hand.

Indicating Mr. Clarke practicing and testing with indicator.

Porter here studying the nature of the work required of engines. one of which I believe has been ordered by Mr. Edison

Saturday May 1. 80.

Armature which had been brought back from Steamer Columbia having been repaired was to day shipped back.

Clamps and roller combination for rolling wires in flat and suitable shape for
were devised by Mr Batchelor and sketches & diagrams
making into clamps, the clamp more is of about the same shape as those heretofore in use but of less metal and lighter. Book 51 pages 119 &c.
He also instructed Wm Wright to try nickle for clamps and contacts for lamps.

Lamp conductors. Men commenced laying conductors to Street lamps commencing at generator room with six strands of No. 10 wire ~~for~~ each line running along the tramway. and reducing to five wires about opposite the pond.

after the wires are lain in the boxes they are entirely covered with gas tar and top nailed on.

Meter. Lawson commenced line of experiments to ascertain whether or not the rolling of copper plate injures the surface of the copper to an extent sufficient to cause unequal deposit thereon in the meters.

Journal calorimeter Mr. Clarke made diagram of calorimeter to measure the energy or power lost in journals of the Armatures and requested Mr Andrews to make same. Book 72 pages 145 &c.

Switch or Plug board and wheel for forming and breaking ~~contact~~ current to the small magnets used for

imparting a lateral motion to the Armatures are being finished up by Cunningham for use on Steamer Columbia.

Boiler Mr. ~~Wood~~ H. opened and cleaned out the boiler of engine for the first time since he has been here, but found the boiler quite clean and in much finer condition than might have been expected.

Hydraulic press is in practical use in pressing woods (to about ⅔ original thickness) ~~for use~~ to be cut on the cam wood milling machine for use as loops.

Mercury cleaning. Dr. Moses finds by experiments on mercury that by laying a copper plate on the amalgamated mercury and covering with sulphuric acid, local action is set up which causes the amalgams to separate and leave the mercury clean and pure.

Pump. John Ott taking one of the pumps from dark room apart and carefully taking dimensions of the tubing and all parts ~~there~~ of the pump. and making full sized diagram of same for use by glass blowers. that they may make a number more, of precisely the same size, caliper, &c. to ascertain whether they will give equally good results, and will be put in old factory and thoroughly tested as the pump.

Cam, feed, wood milling machine is being run of wood pressed by hydraulic press on Saturday, and turning out very fair specimens.

Calorimeter frictional. Andrews having completed for Mr. Clarke the calorimeter around the bearings of armature journals, he assisted by C.P. Mott, made the commencement of a series of tests to be made to learn the amount of energy lost by friction in the armature journals Note Book No. 72 pages 148 &c.

Cars The frames and heavier castings of cars for electric tramway were received and men set at work placing the motor in position on engine frame, and ~~at~~ other work at fitting them ready for track.

Old factory. Along Rail road is being cleaned up and repaired preparatory to putting in pumps and lamp manufacturing apparatus.

Absentees. Kruesi Upton Force, Cunningham and Jehl in New York fitting up lamps, switch board, &c. on Steamer Columbia.

Wood loop lamps. Some lamps of wood carbon were measured and tested by Mr. Upton and he finds those so far made, to be uneconomical, considered due principally to the ragged or feathery surfaces. the lamp with veneer cut loop gave 7½ candles and came down to 60 ohms hot - Book 63 - unpaged.

Clamps. Ott making very light clamps of copper. Hammer of Platina, to be tried in experiments with different metals for clamping. Hammer, one very light platina clamp, about one third the weight of those heretofore used, in a lamp which was taken off the pump in nice order.

Pumps, preliminary work on the set or series of pumps of style and dimensions of one sketched and measured by Ott, was commenced by Boehm. Making

part of 476 gauge reservoir., see order and sketch of Mr. Edison Book 68 page 85

. Mr. Hornig making diagram of new pump to be set up and used in the factory for handling the mercury for the 476 pumps to be put up there, in which they are putting down floor.

Lamp Mould. The metallic mould for lamp bulbs were secured on a permanent iron base and arranged with spring to open and cord and pulley treadle for closing (? works very completely. Elzer here with two samples of lead glass tubing, and took with him one of the globes blown by Boehm as models from which to make wooden moulds.

(~~[illegible]~~

Amalgate Mercury Dr. Moses amalgamated a quantity of mercury with one per cent of zinc. to experiment on its ability to electrolyse and purify itself.

Circular seive. Crosby made circular seive in graduated sections to separate sand in uniform parts for further experiments with air blast separation.

Conductors started South from Station with twenty five strands to each line.

Frictional Calorimeter test being continued by Clarke

Mercury. Amalgamated yesterday by Dr. Moses was found to have purified itself by electrolysis. he today amalgamated a quantity with zinc, lead, and tin with from one to ten per cent. of some one per cent zinc electrolysed in about two hours.

Clamps of Nickel, Copper and platina made much lighter than the old ones were put in lamps and one lamp with light platina clamp was exhausted, frosted and by Mr. Edison brought up to intense heat and light and stood beautifully.

Frictional calorimeter test of the ~~of the~~ energy lost by friction in the journals of armature finished and computed by Mr. Clarke. In one test of the journal next to commutator he found it to consume 900 ft pounds

in another test of same bearing found 1040 ft. ohms consumed per minute - Book 72, pages 189 &c.

Cam feed. Machine for cutting the outside of the wood loops on which Mr. Batchelor and Dean have been at work for three or four weeks was finished and is being used to day in cutting the outside only, and is very complete for that purpose; other cams being necessary I believe to work the inside of the loops, and they are now at work on them.

Opaque or crystalline globes. Lawson experimenting on coating surface of globes with crystalline by fumes did not find ~~find~~ the process so reliable as the acid bath heretofore used. but lacked oxalic acid to complete the experiment.

Pumps. Hammer informs me that he alone took Twenty seven lamps off the pumps upstairs yesterday and mentions it as quite an achievement.
He had observed that the Sprengle drop pumps more frequently broke or cracked at the point where the drop strikes the solid mercury column. and on having a section of the tube cut out at that point and examining it, found it contained innumeral small cracks and one place where they had apparently combined and formed larger crack not entirely through the tube but sufficient to greatly weaken it and show that the constant hammering at that point was the cause of final breakage

Conductors South from Station and all put down hereafter will be put in dry ~~box~~. unmarred boxes and only tarred put

previous to nailing on the covers probably fully as good as the more expensive and laborous way of using ~~tarred~~ boxes, previously tarred inside and out as those first sent out from Laboratory.

Visitors A gentleman from Silver City New Mexico here and had with him some exceedingly rich gold ores.

Thursday May 6

Frictional test: Mr. Clarke made further calorimeter tests of the journals of Armature, using water much cooler than the air, and got one and one half degrees difference between inflow and outflow and as a result 1668 foot pounds against 900 and 1000 obtained in previous tests, showing that the relative temperature of the air and water used vary exceedingly the results, but as an average he believes the journal next the commutator to consume about 1200 ft pounds and on the assumption that the other journal uses 2/3 or 800 ft lbs. or the two journals use 2% of the energy of three horse power applied to generator. Book 72, page 166 &c.

He is also taking indicating cards of the engine.

Malachite. Lawson pressed on the Hydraulic press some Artificial Malachite to see whether it could be solidified or brought in condition to be used as the natural is. Had not mould

John Lawson

to give it sufficient pressure but is satisfied from the experiment that it can be done if sufficient pressure is used. Also made a chemical experiment but I could not learn the object or result as he calls it his own private exp. and not connected with the branches in use or in experiment here.

Gang Saws. Wm Wright at work on gang of small saws 1/50 of an inch in thickness for sawing off the loops from the milled blocks of carbon feed machine.

Work general. Dean making tools for wood milling machine. Cunningham and Logan on small Dynamo. Batchelor and Wright on milling machine. Anders on gas annealing apparatus for annealing the outside globe at point of connection with inner tube. Dr Moses continuing experiments on the electrolyses of Mercury. Men putting down conductors and others putting down floor in old factory.

Pull back. Heard Mr. Edison tonight explaining to Mr. Batchelor and others his theory of the cause or point of "pull back" in revolving armature. his view being that the pull back action is entirely in the copper wires and independent of iron core. and quite fully explained the action going on in them whereby the pull back was caused.

Friday May 7.

McLaughlin. Two samples of tailings from Oroville Cal. were received to day from F. McLaughlin and were being tried by Mr. Edison

Lamps & small lamps with lamps of copper and nickel were exhausted on pumps to day and heated up and so far appear to stand as well as the larger platina ones.

Moulds. Mr. Hornig devised and made diagram of new square nickel mould capable of holding and carbonizing twenty five loops at once a five tier of five loops each.

Lamp Machine. Mr. Batchelor devised & made diagram of a machine for making the small lamps.
Book No 51 page 137 &c.

Contact. Flammer making by suggestion of Mr. Batchelor an instrument or tool for grooving copper wire at point of contact with platina wire. to avoid if possible the necessity of soldering the joint it is composed of an iron block in which is made a saw cut sufficiently wide to just admit the copper wire, a light bar of steel about one fourth of an inch in width and of a convenient length is reduced at one end to the width of the slot or saw cut. and on the extreme end made still thinner and wedged shaped. so that when driven down on the wire it forms a groove therein. which admits of the platina wire and may be closed by pressure around them making a neat connection or joint.

Messenger Electromotor. I find in Book No. 80 page 119. A sketch and description of an idea of an Electromotor for use as a messenger carrier
And in same Book (80) page 122 an idea of varying the electromotive-force by speed of engine.

Large Generator. Upton and Clarke working on arrangement of large magnet in connection with engine or motive power, and on the dimensions weight, &c. Clarke's Book No. 72 page 170 &c.

148

149

Saturday May 8.

Tramway The wheels and other castings for cars of electric tramway were received this morning. and men at work putting them together putting on seats and arranging piping for awning frames.

Clamp Machine Mr. Batchelor devising and sketching a machine for making the clamps. entire, without handling and running through the different machines as has heretofore been the custom. diagrams and descriptions of same in Book No. 51 pages 145 &c.

Annealer. Annealing apparatus for outside globes finished and taken into glass house - entire - It is composed of a wooden frame, grooved or rabbited in which a

or carriage
board slides, ~~in a grove or rabbit.~~
at equal distances apart in the
board are holes about one inch
in diameter with screw threads
cut therein and wooden screws
cut to fit. through the wooden screw
is a smaller hole through which
the upper end or neck of the lamp
is placed. the object of the screw or
being to raise or lower the lamp so
that the propper point may come
in contact with the gas flame.
parallel with and about three or four
inches above the frame are secured
on each side a gas pipe in which
small burners or jets are arranged
to throw against the desired point of
the lamp. three flames from each side
each striking the lamp at different
points on the circumference, The flames
are graduated so that every time

the board or carriage is moved in, the
proper distance the lamps each time
are passed to flames of less heat.
The whole is then incased in sheet iron
to retain the heat and keep off the air.
see April 23.

Visitors Mr. Lowry of E. E. Light Co. with
another gentleman was here to day.

Sunday May 9. 80

Engine. Men cleaning and whitewashing walls of engine room. and Mr. Hood took out grate and renewed fire brick and also some of the grate bars.

Globe mould. Holzier blowed about one half dozen globes in the metalic mould. and treated them into the acid solution. It may not require so much skill to blow in mould as offhand and therefore with cheaper labor, but as for appearance and time I think there is no advantage whatever in the mould.

Monday May 10. 1880

Conductors. Four strands No. 10 wire were run from Dynamo Room to R.R. Station to supply current to the rails. This will make five circuits from the Dynamos. one of six wires North ~~from~~ one of 25 wires South one of 18 wires west and one of 16 wires east.

Carbonization Van Cleve cut and carbonized some card board loops leaving them closed or connected at ends and found them to retain their shape much better than when open.

Mercury Pump. Mr. Hornig calculates 1000 lbs of mercury will be necessary to fill pipes and pump of capacity sufficient to 200 vacuum pumps. Mr. Edison decides to run the large Pump with electromotor instead of Steam.

Cam Machine is to day cutting inside of loops and finishing them up ready for saw. three of which were made to day and tried. The opperation so far shows a very large percentage of broken loops and the ultimate practicability of cutting the loops in the required shape is very questionable

Meters. Lawson put Meters in line of Dynamo current, to be tested for accuracy with readings of Galvanometer and calculations by Francis of the amount of copper that should be deposited.

Andrews finished up working model of Electrometer. ~~and~~

Autographic. Instruments taken apart and all cleaned and polished up by Mr. Kinney, Experiment with the prepared paper used by Stearns on

Autographic by laying the paper on tin foil connected to the wire and using other wire on paper. showed marks only when the one pole (could not tell which) was used as marker. changing to the other pole giving no results whatever.

Small clamps. Several lamps with small light clamps of copper and platina were lit up in Laboratory to test them. copper apparently standing as well as any, but Mr. Edison observed by close examination a beautiful bluish appearance around one of the clamps and on reversing the lamp the appearance showed itself only on the opposite clamp showing the action to be the effect of one of the poles only. which Mr. Upton for reasons given shows to be the positive pole. and attributes the color to copper vapor. and a gradual destruction of the

clamp and proving that copper will not stand long for clamp.

Visitors. James Egan a former employe of Mr. Edisons with two friends here.

Mercury cleaning. Mr. Edison requested Lamson to make an experiment with mercury by covering the surface of impure Mercury with chalcophrite. A sheet of blotting paper was then placed upon the mercury and on the bottom was passed a thin sheet of carbon. Dilute Sulphuric acid was poured into the vessel covering a carbon plate, the carbon and mercury were then connected by a platina wire and set away for a few days. See Book No. 40 page 111.

Carbonization. Van Cleve carbonized two moulds of wood loops cut by the cam machine. rather indifferent success.

Elec. Tramway. The road or track for elec. tramway was all balasted and finished up ready for cars, and Main Force put plug board in Station, and

connectin the wire with the rails

Large Lamp. Mr. Edison made sketch of large power incandescent lamp and gave same to Mott from which to make Patent Office drawings. The connections being made through mercury in glass tubes Similar to apparatus made for carbonizing in vacuum, described under April 4.

Visitor Stout of Stout & Van Winckle was here and received an order from Carman for 100 tons of coal.

Absentee. Mr. Carman left for a trip South expecting to be gone about ten days.

Prony test. Mr. Upton making prony test of motor in Laboratory.

Wednesday May 12.

Tramway Motor was connected up and wheels raised off the floor and tested, found to run like a top. Connections made from Dynamo to wires running to the track.

Tests of Motor in Laboratory were made by Mr. Upton with Bradley methods for studying the principles and making calculations. Book No. 48 pages 53 &c.

Pyrites Lawson experimenting on the decomposition of Auriferous Pyrites. He first reduced it to impalpable powder. An iron tube was then placed in a gas combustion furnace all at an angle of about 60° and when tube about red hot the powder was poured in and allowed to run slowly through the tube. and "came out good". Probable that the experiment is for purpose of eventually extracting metal from the powdered Pyrites

Copies of specifications and drawings of part of Mr. Edisons Elec Light-Patents were copied and sent to American Consul at Geneva Switzerland

Stolen. One of the Large Street Lamp globes was taken from a tramp by a brakeman on Penn R.R and by him returned here, the tramp skipping from the train at Metuchen.

Preliminary Statement of T. A. Edison was drawn by Mr. Edison and copied by Mott in evening.

General Work Andrews at work finishing up the working model of electrometer. Dean still on wood milling machine Cunningham and Ott on Small Dynamos. Several on Electric Engine and gang laying down conductors.

Absent. Mott went to New Brunswick to see Butler in relation to Lamp posts. saving Holly. Bill of lumber for Mr Batchelor and to do some private business for Mr B.

Electric Tramway The electric engine was finished and put upon the track It started off and run slowly with current of 40 Volts after which Mr. Edison put it up to about 120 volts and that current gave it much greater power. the test so far as made shows the electrical parts complete and successful. but by nervousness and inexperience, Mr. Hornig who was running the motor, threw the friction gear on so powerfully and suddenly that he broke one of the Large friction wheels and thus ended the fun for today. the men are now putting on belt and pulley gear to further test the electrical application. until they can devise new gear or get castings for to replace the broken ones. Late in evening Mr. Edison suggested Martin Force put up connections and five

double eccentric mechanical movement for use in engine instead of friction gear and it was decided to make a trial of the substitute

Electric Lamps in R.R. Station and repair work is being done in there.

Mercury Experiment. Dr Moses conducting experiments to determine the nature of and what if any impurities or foreign substances remain in the mercury after electrolysis, so far has been unable to discover any.

Wood loop. Two lamps of wood loops cut by Milling machine were this morning tested by Francis. Resistance cold 148 & 152 hot. 98 & 104. with 90 Volts and 15 candle power he finds 8.5 per horse power; a good showing. They were then hung up in the Laboratory and in afternoon when Mr. E. put up the Electro Motive Force for the electric tramway, one of them went up. but the other still burns.

120 horse power Dynamo. Mr. Clarke finished details and diagrams for the large 120 horse power dynamo. Estimating weight of Magnets at 10.000 pounds. Zinc bases 1,300 in round numbers and total weight 5.2 tons. Armature 2500 lbs Calculations Book No. 72, page 186 &c.

Small Armatures. Tweed is winding the Armatures for the small Dynamos. with but one thickness of wire. with three strands to the notch.

Ore Crusher. A No. 10. Blake Ore crusher was secured and put in use this morning

Friday May 14. 80

Eccentric gear. Sketches of double eccentric gear for application to electric engine dated May 13. and sketches of several devices on one card made by Mr. Edison and described under date of April 20. were brought in and put on Mr. Wilbers Book. up stairs

Meter & Motor tests Mr. Upton had large meter connected with current of main wires and two small meters on a shunted current to make a comparative test. also made test of motor in connection with meters. Book No. 48, pge 61.

Andrews is making small Prony Dynamometer to test the small dynamo nearly completed

Tramway Engine. was fitted up with belt and pulley gearing and after the belts had been well rosined

and clung to the pulleys. The car was run a number of trips to the curve and return. and made one trip with nineteen persons on board and on return trip the momentum given by the extra weight was so great that with both driving wheels sliding she struck the bumper in station with sufficient force to raise it and force the end of station out over a foot. one trip was made to the further end of road. but the power was not sufficient to bring the motor back up the steep grade and short curve. In evening the men Logan Smith and Andrews were arranging for a two foot pulley on extra shaft in place of 14 inch one that was on. for purpose of getting more power at sacrifice of speed. The absorbing topic of discussion is elec engine and gear for same.

Carbonization Several moulds of Bast fibres were carefully prepared and formed around wood for carbonization. but the wood proved very detrimental, every one ~~having~~ being broken in the moulds during the process. Van Cleve is preparing some more for trial

Saturday May 15

Elec Tramway The electric engine was fitted with larger pulley for more power on belt and pulley gear, but almost immediately on starting, it was discovered that something was wrong about the motor and upon examination it was discovered that a cross had occurred. The armature was taken out and into the Shop where Mr Upton and Kruesi removed all the wire and found the cross to have occurred in some of the first wire put on, being the extreme inside wire ~~and~~ crossed at the shaft. Mr Andrews was immediately set at work on another armature, to have it ready for trial on Monday.

Sketches of different ideas of gearing for electric Locomotive. by Messrs Batchelor, Edison Honig &c. Book 51 page 167 &c. Wedge principle idea page 179 same book

Tailings Five small bags of tailings were received this morning from Placerville Col. Sent by Dr A. D. Williams. 723 Chestnut St St Louis Mo.

Carbonization Chs. Flammer prepared moulds of Bast fibre by securing the ends of the fibres in notched ~~Carbon~~ strips without using wood and got them successfully carbonized.

Absentees Mr. Clarke is in New York for purpose of getting from Babcock & Wilcox data and information in relation to their boilers economizers &c.

Meter tests ~~Geo.~~ Upton conducting a series of tests on Meters Book 48, page 77 &c. ~~Shunts of copper wire and and German Silver wire used as shunts Amount deposited in Meter weighed and the main current calculated to discover the [illegible]~~

Monday May 17

Engine. Yesterday Mr. Hood took head out of cylinder of engine to examine clean and oil up. found it allright and in nice order.

Armature Yesterday Cunningham and Andrews worked all day on another armature for electric locomotive and the same was put in place this morning.

Tramway after changing the smaller pulley on counter shaft for a larger one the Locomotive was again tried, ~~with~~ very satisfactory results. Mr. Goddard who was here ~~seemed~~ well pleased with several rides he was given over the straight station. Mr. Babcock of Babcock + Wilcox also enjoyed a few rides.

Pumps Flint glass tubing for the pumps was received this morning and Bohm is at work on them. Also the ~~[illegible]~~ for pumps were sawed the propper length and sent to Butler at New Brunswick for sawing in the slots. and preparing them for the pumps.

Carbonization Charles Flammer cut slots in nickel pieces to hold fibres in place in carbonizing moulds. prepared some Bast fibre and out of 12 got ten out of moulds in first rate order. convincing himself that nickel is preferable to carbon in moulds probably in consequence of containing less air.

Meter tests Mr. Upton is continuing a series of tests and experiments with meters Book No. 48 page 85 &c.

Absentee Mr. Clarke gone to Philada carrying the diagrams and specifications of Large Dynamo to Porter + Allen Engine builders.

Tramway. The engine with power from one Machine made a successful trip the entire length of the road and return. A second generator was brought out of Dynamo Station and set running in old Dynamo Room to increase the power for Rail Road. the passenger car was then attached and with Nine men on made the round trip very successfully, without accident or assistance, running the return in 1 minute 16 seconds. After which a number of trips were made all with equal success, And all the trials today have been decidedly more encouraging and successful and fully up to the most sanguine expectation with the belt and pulley gearing now in experimental use. The results have been so eminently successful that Mr. Edison and Mr. Batchelor are contemplating extending the track three quarters of a

mile with grade at one point of about 1 foot to seven. and adding three more passenger cars.
Quite a number of visitors were conveyed over the road among others several foreign naval officers. And those who have been so favored speak of the ride as exciting and pleasant.

Nickel former. The slotted nickel plate in which Bast fibres are secured for carbonizing and the one used by Flammer yesterday with good results. was by him made and sketched in Book No. 57 page 124.

Poles for ~~wire for~~ telephonic wires are being drawn and placed across lots to day by Ayers. from Machine Shop to old factory.

Clamp Machine Bradley commenced work on. Machines devised by Mr. Batchelor for making the clamps. diagrams of which may be found in Book 51 pages 144 &c.

Sparkers. Four sparkers such as previously used on vacuum pumps were made to day and exhausted on the pumps to be sent, as I am informed, to West Point Military academy.

Bast fibre (8) ~~Eight~~ Bast fibre Lamps are on Pumps to day being exhausted

Wednesday May 19.

6

Fiber turner. John Ott is making patterns for castings for a machine attachment to lathe for turning down fibre to the required size and full length of five inches

Indicating. Mr. Clarke had glass point made on principle of a fountain pen. drawn down to very fine point and ground smooth on oil stone to use in place of pencil in the Indicator and thus avoid the friction as much as possible. A very fine platina wire is used to keep the point of tube clear ~~free~~ and permit the ink to run freely. He found it to work more satisfactory than pencil. While the current was being used on the locomotive he took a number of indicator cards from the engine. (Dynamo running but locomotive off. he found the energy of the engine to vary from 6 to 9 horse power

and when locomotive running from 24 to 40 horse power.)

Carbonization Van Cleve carbonized seventeen molds of wood loops but with very indifferent results. All of them very tender ~~and~~ crooked and misshapen One mold in which but one loop of apple wood was carbonized came out in better shape than any other.

Recording Telephone. Mr. Edison requested Bergmann to make a very small and delicate Phonograph for experiments in connection with the motograph Telephone The idea being that the ~~motor working the phonograph~~ Phonograph worked by the motor shall receive and record the message and the recipient of the message can at any time convenient, reproduce the message from the Phonograph. Sketch of same dated May 22. Book 51 page 1095

Small Dynamo. The Resistance of Magnets in small dynamo. is eight ohms. At 1640 Rev. and 25 volts on field. gave current of 166 volts. Internal resist of armature .16 of an ohm.

Visitor Mr. Wilber. A Representative of Scientific American and a number of others were visiting the Magnetic R.R. and Mr. Wilber getting up Specifications for Patents on same.

Mr. Carman returned from his trip South.

Fibre lamps. Four Bast fibre lamps were sealed off the Pump in nice order.

Thursday May. 20.

Patents Mott finished up Patent Office drawings of Locomotive and attachments of Magnetic Rail way. and were taken by Mr. Wilber together with the specifications.

Ores Two bags of Ore from Boulder Co. Colorado sent by C. P. Geer agent Ogdensburgh N.Y. were received and tried by Mr. Edison. he pronounces them very rich.

Mr. Upton is conducting experiments to determine the amount of discharge from the magnets of one machine. Book 48 page 125 &c.

Autographic Mr. Kinney has for some time been using the Dynamo current on Autographic. and is today working with excellent results through 4500 ohms wire, and is having very good results through 180 miles of wire of West. U. Tel Co.

Carbonization Van Cleve carbonized three moulds of bent wooden loops by securing the strips in slotted Nickel plates he got them out very nicely and in good shape.

Bast fiber Four of the Bast fiber Lamps were measured and tested with current of 103 volts they gave from 30 to 32 candles and about six per horse power. They were connected to main wires in Laboratory and during the first hour three of them broke in the clamps and glass but the fiber in each instance remained in globe unbroken. Showing the fiber to make ~~as~~ strong carbon but difficult to form good contact with.

Estimates for Magnetic R.R. and Equipments made by Mr. Hornig, Edison &c. Total for road and equipments 10 Miles 30,000 Total working exp. 10 miles $22,00 Book No. 80 page 179

One of the hind wheels of Locomotive formed contact with frame and made bad sparks found to have been caused by bolt projecting and striking frame at every revolution. The Locomotive was run in and all the high gearing removed preparatory to putting counter shaft and pulleys directly behind and on a level with the frame of car.

Friday May 21.

Ores and refuse, Mr. McKinsey returned yesterday from trip to valley gold regions of Canada. This morning Mr. Edison panned some mine refuse, which had been worked by the mine process, and again panned by McKinsey, and found quite a quantity of very nice free gold still remaining therein

Armature of large machine is being wound by Logan with single wire for experimental purposes.

Wood Milling. Dean is jubilant over his success to day in working the cam milling machine with complete success and getting out about 100 loops of box & Holly in excellent shape and in several cases sawing them so perfectly that the whole five loops were left joined at the thick ends. Although ~~loops~~ the machine

have been worked ~~on it~~ for some time with indifferent success, To day is the first Dean has felt satisfied with its working.

Phenomena Lawson used Florence flask on steam bath for converting cupric Sulphide into Cupric Sulphate by means of Potassium Chlorate and Hydrochloric acid, After brisk evolution of gas had taken place for some time. A loud report accompanied by flash of light was observed. This action was observed in two different experiments and in one case the explosion had sufficient force to break the flask

Small motor Mr. Upton making test of small generator wound with three wires. both as generator and Motor. As motor it was run at so high speed that the armature burst. previous to which the prony had indicated one half a horse power.

Meter copper. Lawson finds as a result of exp. notes May 1. That the rolling of copper sheets does effect the surface of the plates. causing unequal deposits therein in Meters.

Saturday May. 22.

Test Mr Upton made tests of some Bast Fibre Lamps and at 15 candles gave 9.8 per horse power Also made photometric test of one of the old card board carbon Lamps to compare the economy and candle power.

Work general. Glass House pushing work on pumps. gang laying conductors to Street Lamps. Three men at old factory preparing building for lamp manufacturing. Mr. Batchelor on Machine for making small lamps occasionaly stopping to discuss gear question for Magnetic Locomotive. Men, changing counter shaft and pulleys on electric Locomotive,

Visitors. Mr. Baily, and also Collins of New York Herald here,.

Monday May 24

Mc Intire. Sundays "Sun" reports death by Drowning, of Henry M. McIntire a former employé here, drowned at Carondelet Mo.

Telephonic Phonograph. Sketches made and given to Mott from which to make Patent Office drawings, mention of which is made under date of May 19. under head of Recording. Telephone

Small dynamo burst in testing as motor having been rewound was to day Shipped to Geneva Switzerland

Visitors. Large party of tourists from Europe and Australia. Absent Mott, home on visit on return Monday night can learn of nothing new or startling.

Tuesday May 25

Carbonization Van Cleve carbonized a few molds of wood loops, securing them in the nickel plates slotted and prepared for them and brought them out much nicer than when carbonized loosely in molds. but melted one mold inside. that showed no signs whatever of melting on outside

Magnetic R.R. The locomotive of electric R.R. having been equipped with counter shaft and pulleys back of car frame and belts of six inches wide was tried this forenoon by Mr. Batchelor Kruesi and Force. They lined the heads with leather, and at first trial trip went off the lower end of track without any appreciable diminution of speed breaking the large pulley and depositing Mr. Batchelor on top

of pile of cord wood without choice of sticks to rest on. Now having found both ends of road. thinks he is solid. The engine was returned and pulley replaced, leather removed from heads after which a number of very successful trips were made

Wood loop lamp tested. at 16 candles 83 ohms cold 50.2 ohms hot 7 per horse power same lamp at 30 candles 48.6 ohms hot. 5.5 per horse power Francis's book unnumbered and unpaged.

Pantagraph Andrews making a Pantagraph of but four parallel arms each three feet from center to center of connecting points. devised and sketched by Mr. Clarke and much simpler in construction and working, than one of Brown's previously used on the engine here.

Visitors. Mr. Bailey here this morning and Mr. Edison went with him to New York. Also Safety rail. R.R. Man with a couple friends spent part of day here

Large Dynamo. Tested by Mr. Upton. Magnet 1.94 ohms Magnet 4 per horse power. 9. volts from Armature running 100 Rev. per Minute. Book 48 page 197 also Book 37 page 192 &c.

Wednesday May 26.

Gum & Resin. In completing experiment on removing Gum and Resinous matter from wood, conducted by Lawson and noted under date of April 9. He found Oak lost 12.8 per ct. and Pine 13.37 per cent. the lowest and Rose 38.76 per ct. Mahogany 31.06 per ct the highest, Dried over Steam bath. They were then exposed to the Air in Balance Room about 24 hours and reweighed. San Domingo Mahogany & Dogwood neither gained or lost. Orange, Sasafras & Mahogany only lost weight. All others gained from 4 to 20 Milligrams, White Pine gained least and Canabola the most by exposure to the atmosphere.

Station. Platform extended all around the R.R. Station Electric head light and bell put on the Locomotive, Mrs Edison and some of her friends riding on same in evening, probably the first electric lamp ever used as head light.

Annealer. Andrews at work on gas Annealer for outside annealing of globes similar in principle to the one described under date of May 8. excepting the present one is being made round and combines part of hub and arm arrangement of the one used for inner wire annealing described under date April 12.

Telephonic communication established between Dynamo Station and Laboratory.

Absentee Mr. Batchelor at New York.

Tests Mr. Upton making further tests of the large Dynamo but with about same results as mentioned yesterday

Brush holder. Mr. Clarke has completed a diagram of new brush holders designed for the Large Dynamo. Arranged to act independently of each other taking much less room than the style heretofore used. and designed for three on each side of commutator.

Nickel Plates. Van Cleve had Nickel plate slotted to exactly fit the wood loops as milled by machine leaving on ends one half inch slotted wide in which the broad part could draw up in shrinking. slots made just deep enough to admit the loop and clear the plate plate placed on top as weight. this style were found to retain the carbons in much better shape during the process and some now have been made by Flammer.

Old Factory. The mercury pipes for the Power pump were received today and the tables for glass blowers made ready for the gas fixtures.

Mercury experiments. have been continued by Dr. Moses and the method of cleaning by electrolyses so completely successful that arrangements are being devised for working the method on large quantities by use of a large number of large shallow pans arranged so the mercury may be drawn from one series to another until thoroughly cleaned and deposited in reservoir.

Ores & tailings Dr. Haid assisted by Crosby is experimenting on economical mode of working refractory ores. and are using the furnaces in c

Visitors Bailey, Wilbur & Goddard

Maj Frank [illegible] and R. R. Caston

Pump boards were returned from A. J. Butler cut and prepared for pumps except the depressions for gauge bulb and other large tube parts which are being cut on the drilling machine. One of the pumps was mounted and glass blowers all at work preparing the others. for mounting.

Bast fibre. Flammer carbonized some bast fibers all originally five inches long and of different diameters to measure for resistance. .040 had 30 ohms. .020 - 105 ohms & .014 - 160 ohms resistance. Three loops, white Holly perfect shape and fine appearance carbonized in slotted nickel plates tested 197 - 270 & 325 ohms resistance. Thus showing great inequality in conductivity without any apparent cause or reason

Magnetic R.R. Motor used but little today but working beautifully. first blood by running over a turkey

Glass Heater. Andrews finished Apparatus for holding and turning the prepared globe glass over gas flame for heating it preparatory to blowing into globes. It is compound of two endless wooden chains each passing over wheels notched to fit and receive the links, which are notched in the center from the upper side with groove sufficiently wide to easily admit the drawn ends of the tubing prepared for blowing into globes, and allow them to revolve lightly therein. Over two other plain wheels is drawn a narrow belt of canvass or other suitable material which passes under the tubes sufficiently close to raise them slightly off the bottom of notch in one of the chains. On one of the plain wheels is a crank and by revolving the belt is moved along and by the slight friction on the glass tubes causes them to revolve as rapidly

as may be desired. By another crank on the chain wheels, the tubes previously placed in the notches are moved along and brought at rest one at a time over the blow pipe ~~glass~~ flame and by the revolving belt are made to revolve and heat equally all around after which it may be lifted out and blown and another immediately moved into its place over the fire by movement of the chain, by means of the crank attached to the chain wheel. See May 31

Visitors Mr. Wilber. Collins (of Herald) and a gentleman from South America.

Absent. In afternoon Mr. Wilber and Mr Edison took a ride, as I was informed, over to Port Amboy.

Saturday May 29.

Ores & tailings Seventeen or eighteen bags of Ores and tailings were received today from Powers claim and sent by McLaughlin. Mr. Edison has been testing some of them Book 50 p 15 &c

Friction Gear. Two moddles of Napiers friction break and same principle applied in a complicated way to reverse gear. were received today, to study their adaptability to the electric engine.

Large Dynamo. The core of the armature of large machine was turned off so the iron would come nearly an inch from the Magnet it was then wound with single wire and tested, gave one volt less than when out full and nearer the magnet.

Pump. One of the new pumps was set up and tried with lamp. a good vacuum was obtained and lamp sealed off in two & one half hours. ~~the~~ Moffet is at work hanging other pumps. as fast as they are completed.

Mercury cleaning. Dr. Moses informs Mr. E. that by electrolysis he has purified all the Mercury. has worked the entire process down fine and is ready to clean up and commence on other experiments.

Work general for the closing week and today two men preparing the sleepers for extension of R. R. Four ballasting and shapening up old track. gang putting down conductors to street lamps 2 carpenters at work in old factory Mr. Batchelor & Force making and preparing to put up clamp machine, Cunningham & Bradley on small Dynamos. Glass House on pumps. Labratory very quiet.

Sunday May 30.

Pyrites. The experiment to decompose mentioned and commenced under date of May 11 was completed to day by Mr. Edison examining the vessel then prepared and set aside. and found the chalcopyrites had neither amalgamated nor disturbed the mercury. see May 11.

Track conductors. Having had heavy rain (the first since the R.R. has been built) and the ground ties and atmosphere being very damp to day Mr. Edison had the ~~track~~ rails tested to find the leakage and resistance carried thereby. It was found to have thirty ohms resistance with one cell of battery and a very slight lessened resistance when numerous cells were applied. And states that at that ratio. five miles of track would leak one half of the current, but no care

whatever has been used to insulate the present rails and the loss could undoubtedly be largely overcome by some attention to insulation.

Telephonic Experiment was made on the rails with a Bell telephone. No results or sounds whatever could be obtained with no current but on applying one cell of battery sounds were sent and received through the length of the rails but not very clear or distinct.

Ores & tailings. Mr. Edison is to day much interested in testing the ores and tailings received from McLaughlin And directed Lawson to make certain experiments for removing the coating from particles of gold so they would be rendered in a state subject to the action of mercury.

Monday May 31

Columbia. Dispatch received this morning from Steamer Columbia states she arrived safe in Rio — and that the Edison light is all right.

Oxides. The apparatus made for carbonizing in vacuum was repaired by order of Mr. Edison, for the purpose of experimenting on reducing oxides at very exceedingly high heat, the attempts to be made both in vacuum and in atmosphere.

Laws of Dynamos. Mr. Upton is conducting a series of experiments to determine some of the laws governing the construction of electric generators, and to study the economical proportioning of the same. and for determining the best method of winding armature of 120 Knee Power Dynamo which has been determined to be constructed with 47 commutators

Glass Heater. The device for carriage of tubes on blow pipes described under

May 28 was tried by Mr. Edison in the glass house to night. I find that the intention is to move the machine with power and use several graduated flames instead of one as intimated May 28. and that it is intended to heat only about two thirds when the tubing can be taken off and the balance of heating and the blowing done in the ordinary way.

Ores. Several packages of Ores &c were received to day. some from S. D. Denton Newport Benton Co. Oregon. And Mr. Edison is devoting a large part of his time in examining ~~and~~ testing and experimenting on them

Absent. Several of the Shop men are absent to day. probably "Decorating" as this is decoration day.

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Tuesday ~~June~~ June. 1.

Friction Gear. Mr. Honig devising and studying means of applying principle of Napiers Friction break to the gear of electric engine and made diagram of a gear combining partially the principle of Napier gear with a clutch and eccentric.

Chlorine water ~~The~~ mining men from California were here to whome Mr. Edison demonstrated and explained the method of cleaning mercury by electrolysis and concentrated medium in few minutes that had been entirely [illegible] and [illegible] its appearance [illegible] of long [illegible] also explained to them how cheaply chlorine water could be made and had a battery jar filled with salt and water, (I should judge about one pound of salt and two quarts of water) a paper partition was then placed in the jar and a carbon plate immersed in each water one on each side of paper the electric current derived from the Dynamo line was then passed through

by connecting to each carbon plate. In very few minutes the gas ~~could be~~ was quite perceptible to the smell and soon after, the water on one side of partition began to turn green and the water of that side smelled strongly impregnated with gas. The process was pronounced a very simple and cheap one. and the visitors were much interested in the two process mentioned as both are valuable to mining interests they were then taken over electric Rail road and their astonishment and admiration was complete, also; explained to them a method of purifying mercury which being used in mining process.

Oxides Dr. Moses had a small piece of common carbon about three fourths of an inch long 1/16 square dished out in center sufficiently to hold a small quantity of Oxide it was then connected by platinum tongs to the wires of the vacuum machine and the current turned on. it was kept at bright white heat for about one minute, but the operation did not reduce the oxide. During the preparations the cap or bulb which formed the vacuum chamber had been broken so the trial was not made in vacuum by which process Dr. Moses expects better results

Bast fibre. The machine for turning Bast fibre on which John Ott has been at work for about a week was tried by him to day but with no success. The machine is a delicately made Lathe on a Lathe bed, with screw feed to be thrown in or out as desired and intended for the fibre to be held taught between clamps ~~attached to made~~. in which the ends are secured and the knife or cutter made to revolve with great speed by light round belt from counter shaft. secured on table in connection with the Lathe. He is still at work on the machine and will perfect it if possible.

Six Dynamos. Mr. Edison made sketch of a combination of six horizontal Dynamos arranged for four bearings. Also sketch of New form of electric governor which increases or diminishes the amount of current by raising or lowering a cylinder insulated at entire circumference of one end ~~of cylinder~~ while at or near the opposite end the insulation gradually diminishes in width till lost in a point

in such manner that in revolving the contacting one half surface of the cylinder will remain in contact with the brush or spring, through a greater or less space according to the perpendicular position of the cilinder which is raised ~~regulated~~ by the ~~speed~~ revolving speed of the governor. Both of which were given to Moto from which he was directed to make patent office drawings.

Old factory The carpenters at noon today finished all present work in the old factory, having made in addition to the pump frame ~~made~~ tables for about twenty-four glass blowers. One double table in center of room to accomodate 8 on a side and one next outside wall for about same number. Also bench to accomodate five persons for putting carbons in clamps & clamps on conductors &c.

Visitors Three young men (Swiss) who made the entire rounds of the place without making themselves known to any one till a short time before leaving when Mr. Kruesi learned one of them to be an electrician with a light and an opponent of Mr E. and his lamp and entire system. "Cheek"!

 Wednesday June 2. 80

Mercury Electrolyses. Mott is making Patent Office drawings from sketches made by Mr E. of two machines used in mining operations (in connection with the application of) to which he has applied, means for keeping the Mercury in good state by electrolysis during the time it is being used in the amalgamating machines. from suitable electric machine the wires are connected one to the shaft and the other to the sheet iron or other metallic lining of a ~~same~~ cylinder or barrell, so that the current passes through the contents of the barrell. probably water and the Ore and Mercury, intended to amalgamate the same. and by the electric current the mercury is kept clean, as his demonstration in Laboratory show that an electric current produces wonderful effects in purifying mercury.

Patent. Herald of to day announces that Patent was yesterday granted to Mr. Edison for magnetic Ore Separator. described under date of Mch 25. wherein magnets are used to change the trajectory of the falling ores or sand. Representative from Scribner's here ~~to~~ ~~get~~ got from Mr. Edison a description of the apparatus and principle. and the uses to which it could be applied. He pronounced it the most interesting if not the most valuable subject he had received from here.

Pumps. which have been idle for past ten days in consequence of sickness of Hammer were to day set at work by Geo. Hill. One hundred of the pumps for ~~Lamp~~ Lamp factory were finished by the glass House last night and are being mounted by Moffett. and tested by Nenig-

Allumina Exp to reduce allumina were again tried by Dr. Moses. He took top from the Mercury Vacuum pump and secured to the plates of same, a charcoal piece hollowed out in center to hold the

Allumina, and the whole placed in the hand vacuum pump and vacuum obtained. the resistance of the charcoal however was so great that the current passed rather like an arc or spark heating the carbon & throwing and broke and threw out the allumina so that no results were obtained. Mr. Edison directed him to make the receiver of carbon reduced to give high resistance only at the point where the allumina was contained.

Gear. Mr. Hornig made diagrams of x gear for electric engine using the Mason's clutch and wire ropes and coupling it 1 to 8.

Carbonization Flammer fixed up a bellow blower in connection with a Bunsen. Gas burner in a small circular furnace. to see what heat he could get on the carbonizing moulds. He got as high heat as needed but owing to the crudeness of the apparatus, was nearly an hour in obtaining the ~~result~~

Van C. got out some very perfect wood carbons from slotted nickle plates.

Water Carpenters are trussling out in Pond preparatory to putting in pipes to obtain larger supply for the boilers.

Lathe New Stewart lathe received and set up ready for work.

Visitors Four gentlemen from Columbo S.A. were here to day and manifested considerable astonishment at the extent of Mr. Edison's works and experiments, and were particularly enthusiastic on the Electric Rail Road. they were taken over the road several times and trip being made down in 3/4 of a minute and return in 1½ minutes. Mr. Upton then measured the wheels of Locomotive and found that to run the 2200 feet of track in one minute the armature would have to make 2200 Revolutions per minute.

Plumbago. Mr. Batchelor had some Plumbago pressed in the hand press in Laboratory for purpose of turning it out in rings of .005 square, to make another experiment with that substance for incandescing loops.

He got one ring off very nicely but not entirely to his satisfaction, suggests to have some pressed on Hydraulic Press. and make some different tools from those used in cutting tonight. hopes by compressing it more solidly and cutting it with tools especially adapted. he can get better results

Wood Milling. Dean commenced on another method and device for milling the wooden loops. The inside will be cut by same process as heretofore. but the outside will be cut with a revolving face tool. and the block arranged on a double carriage and by cams or other devices discussed, will be made to travel along and revolve in such manner that the face cutter will cut the wood to the proper shape and thickness.

Rubber. Pure mercury, was used to test the new pumps and it was found so amalamated that the same was investigated. Dr. Moses took some of the rubber tubing which had been in use

and found it to contain comparatively large quantities of zinc in the inner lining while the outside contained lead.

Cars. Part of the castings for the three additional Passenger cars were rec'd to day

Lamps. The pumps having been idle for some days. the Glass Blowers have given their entire time to making pumps but Holzer is today working on Lamps and will probably be delayed in pump making. by keeping the old pumps supplied with lamps.

Friday June 4.

Elec Motive force. Mr. Clarke finished his calculation of the fall in electro-motive force in a system of conductors and lamps as established and put down here in the Park. with view of devising means of maintaining the same constant and further calculating the additional cost of maintaining it by feeding the mains with extra conductors and at the points where such feeding can be done most effectually and economically. In line of 1800 feet in length supplying 30 lamps of 100 ohms each the decline in electro motive force is from 100 volts at machine to 87.6 at last lamp. and on same line resistance of 100 ohms in first lamp in circuit is reduced to 3.6 ohms when the 30 lamps are in circuit.
Calculations Book No 66 pages 130 to 145 and 160 to 180 &c.

Large Globes. I discovered last evening that some of the large globes were breaking in consequence of the swelling of the pine posts due to the rain and damp weather. Mr. Kruesi this morning sent a man to examine them and about one half dozen were found broken.

Tramway. Bancroft of Boston Herald here and having a few minutes was given a ride over the Electric Rail Road on return trip, the brakes were not put on soon enough to prevent a pretty severe bump against the bumper and giving all hands a pretty good shake up. but no serious damage was done, beyond breaking one seat and bending the iron coupling between car and Locomotive. repaired and ready ~~to move in about~~ and was run in about one hour.

Hydraulic Press. A new armature was put in the Motor in Laboratory and connected by belts with the Pump of the Hydraulic Press to prepare for getting

More pressure on plumbago for Mr. Batchelor's experiment. A cross ~~on~~ each ~~magn~~ each pole of the magnet with the base was remedied on one, but it was found that full current very quickly formed cross with ~~base~~ shaft of Armature and it was removed to be remedied.

Wood Loop Lamps. Fifteen lamps of wood loop were connected in main wires in the Laboratory down stairs for test of their endurance stability

Cars. Two of the carpenters are at work on the frame &c. of the cars for which the castings have been received.

Absentees Mr. Edison went to New York on 3[20] train returned early in evening. Mrs. Edison also went on same train for trip west.

Magnetic traction. Apparatus finished by Andrus to test the efficiency of magnetic traction for giving friction. No thorough test made. Late in evening four batteries were tried but ~~did~~ not give sufficient current to magnetize the discs.

Saturday June 5.

Visitors. Messers Lowrey and Goddard were here and after assurances from Mr. Edison and Kruesi that it was perfectly safe and free of danger were persuaded to take the second ride. over the electric tramway. All went very well ~~until~~ and with fearful speed until the curve at Freemans road was reached, where the motor jumped the track throwing Martin Force and Kruesi off. and running over the ties seventy yards before it came to a stop. No one ~~being~~ were hurt ~~and~~ no damage done. In very few minutes the motor was again on track all on board and running.

Magnetic traction. Apparatus for testing magnetic traction was today tried with current from Dynamo on magnets and the increase of friction or resistance due to magnetism was by means of a scales determined as one half horse power. The machine was constructed with two magnets set in journals at right

angles to each other and with the disc faces in contact at the apex. The magnets were single, about two and one half inches in diameter and six or eight inches long. On the face of one was secured a disc a shade larger in diameter than the magnet and placed so the edge pressed slightly against the face of disc of other magnet, the latter disc being probably ten inches in diameter and the traction or friction was caused at the point where the discs touched, less, I should judge, than 1/4 in square.

Allumina Experiments. Dr. Moses has been continuing experiments to reduce allumina but has not yet gotten the crucible slight enough to give sufficient resistance to get a very intense heat.

Pumps. Holcomb commenced carrying the first lot of one hundred pumps, down to Lamp factory to day.

Wall general. During the week Mr. Batchelor & Martin Force on clamp machine. Ott on no ~~shir~~ turning Bent Fibres. Andrews on circular annealer for outside globes. Bradley and Andrus on apparatus to try the power of magnetic traction. Glass Blowers on Pumps. Two or three on winding track of electric R.R. Gang on laying conductors. Three mounting pumps. Cunningham on Small Dynamos.

Gauge. Lawson had a gauge, sealed to reservoir by Holzer, to determine the increase in volume of water due to the addition of the various salts. equal quantity of salts give same increase in any volume of water, sufficient to dissolve it. Private exp. further particulars not obtainable from him.

Monday June 7.

Test. Mr. Upton again tested one of the small dynamos with about same results as previous tests. He was unable, with 75 volts, to saturate the cast iron bars of the magnets. The inability to saturate is explained as due to the resistance to magnetism of cast iron in consequence of the amount of carbon it contains. Test was to determine the electro-motive force at varying saturation of magnets. Book 48 p 201

Allumina Dr. Moses having made a very thin crucible of box wood and carbonized it, Today succeeded in reducing Allumina to metalic form. giving alluminum of very metallic appearance under the microscope, but no determination of its being really metal was made. The box-wood charcoal crucible was filled between two carbon strips and placed in ~~vacuum~~ pump and good vacuum obtained, the crucible was made exceedingly thin to secure high resistance, and intense heat was given it by the electric current. He is making some more crucibles and will make further experiments.

Ores (?) procured near Washington Rock yesterday by Mr. Edison are being examined by him today. finds in the sample tested, a little copper but no valuable metal.

Mercury Pipes. The pipes (iron) for the mercury power pump were cleaned inside and steam forced in and through them from boiler, preparatory to putting in in lamp Factory.

Brush holder. Mr. Edison made sketches of brush holder for the 120 horse power dynamo and gave to Mott from which to make Patent Office drawings. See also May 27.

Fall of Electro Motive force, or Potential. Nine ~~reels~~ coils of wires of 100 ohms resistance each ~~and~~ representing about a lamp each were made for experiments to determine the fall in Potential or Electromotive force.

Bast Fibres. Ott having for present discontinued work on machine for turning fibres. Bradley has taken up the matter and is making

very simple former and cutting arrangement for getting them out square, and with flat ends for contact. he cut out one or two in evening and the first attempts gave very good fibers gauging almost exactly .012 (as required) and gave very encouraging results for first trials.

SAWYER

Sawyer Lamp. A broken Sawyer lamp was received from some source this A. M. From what has been written about Sawyer's Lamp one would infer it was similar in construction &c. And a rival of Mr. Edisons Lamp. As for appearance and mechanical construction they are about as much alike as a bicycle and compound double condensing engine. And as a rival for practical domestic uses, no more so than a Brush, or any other complicated intense arc light.

Visitors Mr. Ruskas and several others unknown here.

Absentees ~~Ott~~ Mr. Edison Sen. left with McKenzie for a trip in Canada.

Tuesday June. 8.

Ore Twelve bags of Stamp mill tailings from Consolidated Virginia Mine were recd. this morning. Two barrels which had been expected for several days were also found in the yard.

Ties. Some ties from Penn R. R. are being drawn up to use on electric R. R. for more securely holding the spikes being hard well seasoned wood.

Moulds Chas Flammer is slotting some nickel plates in which to carbonize the Bast fibers from the instruments or machine made by Bradley.

Ore washing Mr. Edison connected the neck of a large funnel by rubber hose to the water pipe and filled the funnel with tailings or crushed ores and turned on the water for experimenting on washing ores in that way. the water being forced up through the funnel it was expected would carry off the lighter parts and fine dirt allowing the gold to settle in bottom of funnel.

Potential. Hood ran engine late to night for Jehl to make an experiment with the resistance coils he had prepared each of the ten to represent a lamp of 100 ohms. the purpose of the experiment being to determine the fall of Potential. The fall through the ten resistances was from 84⅞ to 79⅔ volts and from 16½ to 12½ candle power.

Visitors. Mr. Bailey & Puskas. also Diego de Castro Couveree de Chili and several of his native friends.

Absent. Mr. Batchelor went to New York (I believe) to meet his sister.

Chlorine water. Moffett made a box with a double wood perforated partition, set about one inch apart ~~between which~~ and space between filled with asbestos. for experiments on making chlorine gas or water. in the large apartments ~~each~~ to ends was placed common salt and filled with water a carbon plate was immersed in each and current connected. the apparatus worked nicely. and gave good results. same mode of generating the gas and saturating water described under date June 1.

Pumps. Men mounting and carrying down the second hundred of pumps to Lamp Factory.

Fibre cutter. Bradley working still in better perfecting the instruments for working bast fibres.

Absentus. I was absent (at home) during Wednesday and Thursday. learn particulars given above on return. Also that on ~~Thursday~~ the Elevated R.R. men where here

 Friday June 11.

Wood Miller. Dean finished and is trying the new milling machine with face cutting tool. It does not yet come up to his expectation and he is not happy

Magnetic Break. Mr. Kruesi made diagram of application of magnets to operate on double break like now used on Steam Locomotives. To the joint in center of break arms is secured a mass of iron. above which are secured the magnets, which when charged by the current attract the iron at joint towards them very powerfully thus ~~clasping~~ forcing the brake blocks against the wheels.
Mr. Edison suggested several other ways of applying the principle and also suggested and explained the power that could be derived from the insertion of a copper cylinder in the magnetic field

Bast Fibers. Bradley got out a few Bast fibers which were carbonized by Van Cleve. They came out very nicely appearing as smooth and solid as steel. The former in which the fibers are cut is composed of a split steel bar, with groove in outer edge .012 of an inch ~~deep~~ and of same width when the split bar is brought together by pressure. The fiber is first shaved down in a shaver with knife set like knife in a plain. and the fiber brought gradually nearer the knife by screw which acts against it. The fiber after being thus reduced one way to nearly the required thickness is ready to be placed in one of the grooves of the bar and shaved down exact. after which it is placed in the opposite groove and shaved exact the other way, coming out perfectly smooth and square and with widened ends for good contact

Annealer. Five round annealers are now in course of construction. The principle being the same as one described under date May 26 The ~~circular~~ ones now being made being circular and the wooden disc in which the lamps are secured is made to revolve so as to bring the lamp each time in gas flame of less heat until it has completed one revolution of the disc when it is ready to be removed.

Magnetic gear. Mr. Edison made a sketch of an idea by which the resistance of a copper cylinder or armature, to revolve in a magnetic field might be made available as a gear to take the place of a friction or ~~other~~ positive gear. The sketch made by Mr. Edison represents the magnets attached to and revolving with the axle of driving wheels, and a copper

cylinder secured to the shaft of the armature revolving between the poles of the magnets or in the magnetic field. The magnets being charged offer great resistance to the revolution of a copper mass. and thereby make a powerful, smooth gear but not positive.

R.R. Extension. Men are at work on extension of the Rail Road.

Absent. Mr. Edison left on 10 am train east returning in early evening.

 Saturday June 12.

Bast Fibres. Four Lamps were made today with bast fibre carbons made from fibres worked by Bradley on new cutter. one of carbons originally 4 5/8 in long & 12/1000 square gave 336 ohms resistance. Two of the lamps were exhausted on the pumps and heated intensely by Mr. Edison they heated very evenly and gave beautiful light.
Mr Edison observed that the Bast fibres shrink in carbonizing about 17 per cent. against 33 % shrinkage in paper, woods &c.

Ore plating. By direction of Mr. Edison, Lawson commenced experiments on the extraction of silver from ores by rendering them in a state susceptible of being utilized for plating, Some of the ore was taken and enough solution of Potassium Cyanide in water added to make a thick paste of the mass, all was then thoroughly mixed and incorporated and two

copper plates, connected as the two poles of a battery, placed therein, The experiment was very successful and a thick plating of silver was deposited on one of the plates.

Screw Gear

Visitors. Painter of Phonograph.

Work general. during the past week, Dr. Moses continuing experiments on the reduction of Alumina. and on making carbonized box wood crucibles with which to conduct the exp. but has had no further success in reducing it. Glass Blowers at work on pumps. Bradley on machine for ~~dressing~~ Bast fibres. Batchelor, Force. Ott & Andrus on different parts of clamp machine. Cunningham on small field Dynamos. Horning on gear for Elec Locomotive Clarke on means of most economically maintaining the electro motive force in large circuits and systems. Carpenters on new cars and gang on laying conductors And a few on Rail Road extension.

Ore plating. Mr. Edison yesterday, made further experiments of removing silver from ores by depositing it as plating. He added to the ore and water common salt. ~~and~~ immersed the Poles of the battery. it was expected the action of the current would generate chlorine water, which acting on the silver ore would reduce it to Chloride of silver and thus in condition to be made available for plating which is also accomplished by same electric current. On examining it this morning he pronounced it a failure

Papers. Sun of today contains one & a half column article on Edison Electric Light. a very fair, and for that paper, a very favorable article. but the writer take no responsibility ~~for~~ any of the claims. preferring to use Mr. Edisons sayings and declarations, as the basis of ~~the~~ and comments very cautiously.

Shipped New Lathe (Stewart) recd here June 3. was packed for shipping to South America Amberaci.

Bast fibers. Bradley moved with the instruments for cutting out the bast fibers, up stairs in the Laboratory. having cleared up Mr. Batchelors old place for the purpose. He got out in the afternoon about thirty very nice specimens. By suggestion of Mr. Batchelor, Chas. Flammer. cut a cross slot in each of the nickel plates used for fibers. the cut is directly across the main slot at the end or widened part of carbon. the fibers having a hole through them at that point. ~~the~~ small bit of platina wire is passed through the hole and being then placed in the cross slot holds the one end from drawing up in carbonizing and the shrinkage being calculated in the length. it is placed in the plate at such point that the shrinkage will draw up the other end to point. where said cross slot would intersect the opposite heel, and thus bring the ends opposite and on a line with each other.

Mr. Upton made some tests on one of the Bast

fibre lamps but did not entirely complete the test because of the current being required for the R.R. the lamp will admit of one and a half as much again radiating surface and still give 8 per horse power it is now burning at minimum candle power and about seven per horse power and giving one fourth more light on edge than on face. At that heat however, the bluish vapory appearance presents itself about one of the clamps.

Ore Exp. Mr. Edison took a quantity of the samples from Virginia Consolidated mines and placed it in large box outside the Laboratory and is conducting some experiments on it, with the secret process. The material is said to contain gold & silver.

Cars. One of the new cars with removable side boards was put on track to day and a number of English people being here the train was run a long time and on one trip carried sixteen persons down and back very successfully.

Visitors English party & McLaughlin

Allumina. Dr Moses made device for holding the small carbon crucibles between carbons plates lightly held against the crucible on top and bottom by brass springs which also serve as the conductors. He got an intense heat but could find nothing of the contents of the crucible., the carbon plates between which the crucible was held proved not to stand the intense heat. and he is today preparing plumbago discs for that purpose.

Bast fibre The lamp on which Mr Upton made tests yesterday was kept at about forty candles for some time this morning: it was then screwed on the wires for observations on the vapory appearance around the clamp. but broke about middle of the loop soon after.

Partition Lamp Mr. Edison was of opinion that the carbon was being carried from one side to the other of the loop directly across and for further investigation he had a lamp made with a oval shaped glass partition attached between the conducting wires and extending nearly to the top

of the loop at right angles with the faces. The lamp was on pumps but not yet heated.

Gear Mr. Honig devised and sketched a novel gear. for attachment in front of Motor to climb steep grades. its motion and action is very similar to hand over hand climbing, being composed of arms and clutches which grapple the rails, one of each side and by a cam movement the clutch is released arm raised up and extended, dropped down on and again clutched on the rail. the arms acting alternately so that one is always clutched and drawing.

Lamp factory. the iron pipes which have been cleaned and prepared ready for putting up were ~~yesterday~~ Today taken down to the factory Nearly two hundred of the glass pumps are now down there.

Rail Road. The motor was somewhat improved in appearance, by having the wires concealed and the switch levers covered with a board to protect ~~them~~ and conceal them.

The ton car was last night taken off the track

and double break put on. worked with a wheel and chain and the breaks acting simultaneously on the outside of wheels front & back.

Clamp Machine. Is now assuming an appearance that indicates its purpose and the manner of its working. the bender and two punches and apparatus for lifting off the finished clamps are now on none to my knowledge having yet been tried except the spring device for lifting off the finished clamps which works very nicely.

Copper cylinder. Pattern was made for casting of copper cylinder with which to make the experiment to determine the amount of power in copper cylinder revolved in the Magnetic field.

Laying conductors. Work on laying conductors to Street Lamps has been suspended for a few days. cause delay in getting wire.

 Wednesday June 16

Tailings five bags received from Lazard Bros. taken from the Tunnel Mine. some of it very rich a small handful showing eight and ten colors.

Specific Gravity. Dr Moses had Boehm make x a very delicate apparatus for testing the specific gravity of metals ores to ascertain whether they contain metals. It is composed of a small cup shaped pan in which the substance may be placed, joined by ring to a bulb partially filled with mercury above which is a considerably larger bulb containing air and still above is a long slender tube that may be sealed off as desired. the whole is made of glass and both bulbs are made air tight, on top of the neck is permanently secured another cup similar to one on bottom. the apparatus is immersed in water and the mercury in bulb always draws it down to a certain point and by placing the material first in the top vessel and by adding weight sufficient to immerse to a certain point, and then

placed in bottom vessel and weights added in the top vessel to immerse to the same point the specific gravity may be calculated or at least that is the modus operandi of Dr's experiments made to day..

Alumina. Dr. Moses tried another experiment to day on reducing Alumina. using plumbago discs as conductors in contact with the charcoal crucible, the product ~~showed~~ appeared very metallic under the microscope. but Mr. Edison thought it was fused alumina, the plumbago crumbled almost to pieces under the heat, The stop cock was opened to admit the air before the carbon and parts had lost their red heat and the instant the air reached the globe & the covering of the pump. an explosion occurred breaking the globe. It was thought due to the formation of carbonic oxide which was ignited by the heat of the crucible

Absent. Mr. Batchelor left to day for a trip with x his family and sister.

Spectroscopic examinations of the fibre lamps were made to day by Prof. Young. he got carbon lines in all cases except on the last lamp tested which was the partition lamp with low vacuum. he got two lines of Hydrogen Having been convinced that the vapory appearance and slight deposit on the negative clamp was carbon in some form. the questions arose as to the cause, remedy, and whether the carbon was carried along the loop or passed across from one side to the other, The action being observable only when lamp is at intense heat and current of high electric motive force, Those were attributed as the causes. and by discussions it was concluded that the carbon was carried along the loop and not across. as was supposed by some. To further convince themselves of the action, An experiment was made by, placing a thin copper wire in a W shaped glass tube filled with Metal solution. and passed the current through to observe the action of the deposits of the copper and the points from which the metal was carried.

On the first experiment the wire was eaten off at the positive connection or clamp and ~~d~~ again reduced quite thin at about one third of the length of wire or at point where the larger part of the carbons have broken. and depositing of the metal heaviest as it neared the negative connection This experiment showed that the carrying was entirely along the wire. as no means were allowed for the current to pass or jump across. further experiments are being conducted. ~~as~~ As remedies it was suggested to reverse the current frequently, as another to taper the carbon thereby giving it more substance to loose, and permit it to equalize itself. Another was by use (in some way) of magnets— and experiments requested to be made on the different ideas.

Rail Road. Marty with his men commenced to day working from six oclock till dark, on the track of electric Rail Road and to night made great improvements in the curves and track down nearly to Moffetts crossing.

Gum & Rosin. Lawson extracting gum & Rosin from Bast fibres. for ~~making~~ carbons for use of lamp experiments

Lamps. The lamp made with glass partition and tested at intense heat yesterday and the one from which the Hydrogen lines were obtained in spectroscope. was broken in the carbon today. Other Lamps were made with mica partition extending down nearly to bottom of large globe. one was exhausted on the pump and heated up Mr. Edison then for experiment let air in so the guage mercury filled about three-fourths the globe and burned it at high incandescence for long time the lamp showed all the characteristics of lamp with high vacuum and showed the vapory blue the same as the plain Lamps.

Two half length Bart's were gotten out by Bradley and carbonized by Van Cleve, to be made in two lamps in series to replace one of present Lamps for experimental use.

Magnetic Separator. Hammer placed a glass between the face of the magnets and the line of fall of the sand. claimed it to work better by keeping the magnets entirely free and permit of no clogging of the magnets.

Wire ~~Lamp~~, representation of Lamps. The wire left in U shaped tube filled with metal solution last night, was examined to day and found to have been reduced at same points and augmented the same as the first experiment made, and the diminution of the wire in both cases represent the points at which the carbons usually break. An iron wire was tried in a solution of common salt and Ferricyanide, Potassium but no light was thrown on the subject by the experiment.

Poles. for telephone wire and conductors for current from Dynamo Station to The Lamp Factory were put up this morning.

Ore Two gentlemen were here to day with Ore and tailings of Dry placer.

Drawings Mr. Hornig made sketches, on three sheets of gear and of engine when equipped with the gear, and gave same to Mott from which to make Patent Office drawings and he is now at work on the same.

Magnetic Brake. The magnets for one of the small field machines, made with soft iron core and wound three layers of .042 wire was placed on one of the benches in the shop and a square iron mass secured one to each end of core as a base. a bar also of iron was ~~secured~~ taken, about one by two inches and 10 or 12 inches long, placed between the base blocks so the surfaces just touched but not sufficiently to hold the weight of the bar. current was then put on the magnets (about 1/2 of a horse power) and the bar was held in position with sufficient power to hold up a 100 pound anvil. Mr. Edison by exerting almost his entire strength ~~to push it through and~~ could ~~push~~ it through. The experiment was made to test the power of magnets in application as Brakes.

Freeman cut nose badly with hatchet. off work.

Taper Loops &c. Mr. Edison directed Bradley to select some test loops with varying imperfections to study the effect in the light and the stability of them when containing pith. hard outside, and irregularities in cutting. Also to make some with a taper of .003. to be tried as an experiment in the carrying tendency of loop. and to see whether it will equalize itself.

Mica partition. A lamp with mica partition mentioned yesterday, was broken this morning by Mr. Edison on the pump by intense current. Another was made and is on the pump.

Half lamp. One ~~half~~ carbon just one half the length and same dimensions of the long Bast fibers was put in a lamp and exhausted this morning. The lamp was hung in the Photometric Room, and brought up to 36 candles and left at that heat for some time. it was then lowered and gradually raised to twenty eight candles before blue could be observed and then not in clamps but diffused through the entire globe

the Lamp was then gradually carried up to nearly eighty candles and stood nearly a minute before it broke in the carbon. This was unquestionable the finest Lamp ever yet made showing the power & durity of the Bast carbons and opening a new field for experiments. Mr. Edison made sketches of two of the half-lamps (as they are called) in straight tubes instead of globes and arranged in series Note Book No. 63 page 167. Fibres are being cut with which to make several of the lamps ~~and~~ to further test their merits.

Gold Ore. Dr. Moses took a evaporating dish and in bottom placed a carbon plate with wooden frame on edges and extending to the outside of pan. On top of the frame was placed another carbon plate, leaving a space of probably 3/4 of an inch between the two plates. The dish was then filled with salted water and gold ore very finely powdered mixed in. The poles of batteries were then connected to the plates and allowed to remain over night. The object being to have the current

generate chlorine gas in the solution, which will act upon and dissolve the gold which may then be precipitated.

Magnetic Brake Mr. Hornig made sketch of an application, of the principle demonstrated & described under date June 17, for a magnetic brake on cars. The small magnets are secured to the frame of the car. A cast wheel is secured on the axle so that the outer part may revolve between the bases of the magnets, which are secured by bolts, ~~the bases~~ in slotted holes in such way that they may be kept from contact with wheel by a light spring when not used, but when current is given to the magnets the base blocks attract themselves to the opposite sides of the wheel with great tenacity and thus make a powerful brake. The sketches were given to Mott from which to make Patent Office drawings

Small field dynamo. soft iron core, tested by Mr. Upton.

Saturday June 19. 80

Hot air Engine. The small engine with which the experiments with exhaust steam as fuel were made was to day shipped to Delamater Iron works New York.

Electric Locomotive was improved in appearance by a thorough painting.

Gold Ore, The experiment commenced and noticed yesterday - was examined this A.M. by Dr. Moses the contents of the evaporating dish were filtered and the very small quantity of the liquid precipitated by Moses showed gold in sufficient quantity to indicate that the operation had done complete work, the liquid and solids were then taken by Dr. Haid. Dr. Moses believes the experiment shows the process to be economical especially in ores that do not contain too much metal other than gold. As in presence of other metals the chlorine would act first upon them and leave the gold till the last thus requiring longer

time to do its work than it would in pure gold ores. and the question of economy would to an extent depend upon the time required to complete the process. See June 22

Lamps. Some four or five half lamps were made to day and two in tubes instead of bulbs put on the pumps ready for exhaustion Monday morning.

Dynamometer directed to be taken off and belt which has to day been prepared by Andrus to be put on connecting direct from Main to Dynamo shaft.

Absent } Mr. Edison and about all the Fishing } men except some in the shop, left here about four o'clock P.M. to take a Schooner (hired for the purpose) at Woodbridge for an excursion and fish, expecting to remain away until Monday night.

Work general of the week. Several in shop at work on patterns for Motor gear. Men & Ayers team on Rail Road extension. Mr. E. interested and experimenting on Bast fibre lamps. Batchelor still absent. Cunningham on small fine armatures.

Dynamometer. taken off and the main and Dynamo connected by direct Belt-

Half lamp. Jehl tested one of the half lamps of 70 ohms resistance cold. heated to 11 candles dropped to 40 ohms the test was not completed in consequent of no current in evening.

Specific Gravity. Dr. Moses had Boehm make another apparatus for testing specific gravity. Sketched in Book 68 page 123 The Dr. is good on apparatus (Pardon if I feel at liberty to express herein my own private views I should remark he is H-ll on apparatus)

Ties Old hard wood well seasoned ties are being drawn by Ayers from Depot to use on curves and joints of the Electric R.R. One car load of which were ~~stretched~~ delivered there on Saturday.

Glass Visitors. A Glass Manufacturer from Corning N.Y.

Fishing The excursion returned about 10 o'clock this Morning. All pretty well browned, and tired. Engine & shop not running tonight. No much fish. Low water.

Half Lamp. Two in small tubes were put up in series at about 45 candles to test their stability, average life about 1 hour at that heat. A single full lamp was then put in rather shorter lived at same incandescence. Three other half lamps were sealed off the pump resistance cold. 67. 69 & 81. the loops in regular globes. Two were placed on the wires in series at 56 candles and remained so 2 1/2 hours before breaking, These gave 5.4 per horse power at that heat. or the 300 candles per horse power. The survivor was put at 9 candles requiring 2580 ft pounds or 285 ft pounds per candle. And at 8 candles 2020 ft lbs Book No. 48 page 181. &c.

The better economy of the regular globes over tubes is probably due to the small tubes, being nearer the ~~glass~~ carbon, conduct away the heat more readily.

The fine fibres as cut now, are 4 1/8 in long by .312 diameter square, and the small ones are same diameter but precisely one half in length. Bradley is now cutting some 2 7/16 in long. have not yet been carbonized.

Electric R.R. Mr. Edison run the motor around the short curve (30ft radius) several times to day. On starting from the Station when current was first put on, the Armature of the newest machine, the second one in series, was burned out on examining it it was found that the solder had melted and commenced the cross at the commutator head, and the armature was entirely unwound. A new magnet and armature were put in and connected up. No test of it has yet been made.

Ore experiment of Dr. Moses ~~made~~ commenced on Friday June 18. was further examined into this morning by placing the carbon plates used in the experiment, in a solution to discover whether they had absorbed any of the gold in the solution. The plate connected to the zinc pole of battery was found to contain a considerable quantity of gold. The solid residue examined by Haid also contained some gold

Office. New Book case being put in today and partition built around the head of the stairs.

Small field dynamo was tested by Mr. Upton as a motor with Prony Dynamometer which indicated about 19.440 ft pounds. The shaft of Prony gave out before the test was entirely completed. Book No. page.

Bast fibres. Some choice specimens of Bast fibres were brought tonight by Hughes.

Ore. Lawson tried an experiment of depositing silver and gold on soft iron turnings by use of battery current. The ore was taken just as it comes from mine. but no results were obtained. N.G.

Power Mercury Pump. was delivered at Lamp factory this A.M.

Wednesday June 23.

Exp. with copper wire in straight glass tube filled with Miller solution. the current being passed through the wire it was eaten off at clamp or connection with carbon pole. An iron wire in form of loop was then placed in evaporation dish with a solution of Salt & Potassium Ferricyanide. In this case the stronger the solution was the more local was the carrying and on diluting it the carrying extended for a greater length along the carbon, next the carbon pole of battery.

Fibre Lamps. One of the half lamps in full globe was tested at 22 candles. 67 ohms cold. burned 3 hours 13 minutes. Three half lamps in tubes sealed off the pumps and heated up. the carbon however was so close to tube that the glass was melted. Full lamp was then tested at 40 candles and gave six per horse power. and lasted at that incandescence for 2 hours & 15 minutes.

Carbonization. John Ott finished a new former by which to cut the slotted nickel plates in which to carbonize bast fibres. and got out a plate or two which were used to day by Van Cleve and several very fine specimens of carbons gotten out by him from them.

Donau fed Dynamo was set up in the Dynamo Room and belted to shaft of other dynamos; The present pulleys give but 1500 Revolutions per Minute. and current only sufficient to heat one lamp to bright red heat, The pulleys will be changed to make it 2500 Revolutions and better results can be obtained.

Ore Experiment. Dr. Moses having found gold in one table spoonful of the original solution of experiment mentioned June 18. and also in one of the carbon plates used. the experiment was commenced over again today by Dr. Haid and Crosby. the latter Dr. not having found any gold in the solution of the first experiment which he treated.

Nitric Acid. Lawson took some calcium carbonate and made in paste with aqua Ammonia. And immersed the poles of a battery to experiment in making Nitric Acid. After remaining some time traces of Nitric acid were found.

Visitors Perkas & Bailey, two other French gents also Livingston a former employee.

Absentee. Clarke gone to Philadelphia and to examine an instantaneous generator.

R.R. Run around the sharp curve to day but the wheel of the counter shaft cramped against the coupling lines so hard that it was unnecessary to uncouple and shove the car back around the turn.

Lamp factory Cunningham, Andrus & Johnson commenced in lamp factory this morning by preparing to put up some mercury pumps.

Bast-fibre lamps. Small loop at 22 candles lasted. 3 h. 13 m. one at little more than 22 candles stayed 2 hrs. 30 m. Longest life in long carbon today 1 h. 12 m. The most economical was a half lamp, and one dipped in Plumbago solution was uneconomical and short lived. The economy varied considerably. Lamps tested in the evening did not show so economical by from 17 to 20 ft. lbs. per candle as the same lamps did in day time, attributed to the reading of the photometer, as in evening, the resistance read lower and the volts higher to give the same candles.

Book No. 89 - Page 219 to inc.

Gear. Several of the men in shop at work preparing the gear castings for the electric locomotive.

Carbonized tissue. Dr. Moses appearing to be out of a job Mr. Edison directed him to analize some of the Carbonized tissue paper from the Moulds and he is preparing for the work.

Magnetic Separator. Mr. Honig is designing the arrangement of magnets and hoppers for a working system of magnetic separation.

Absentees Mr Edison went east on 11 20. Mr. Clarke also absent towards Philada.

Loops. Bradley cut some from Osier willow and some from palm leaf of different sizes and lengths. The willow were carbonized by Van Cleve, but not taken out of moulds today.

Gems. Hidden here today and brought for Mr. Edison some cubes of choice gems and ~~precious~~ rare stones. &c.

Papers The Scientific American now out of date July 3. contains a cut & description of Guests Improved electric Lamp. The improvement claimed being the use of mercury in the tubes for sealing the platina wires and in carbonizing the loop on the wires instead of clamping. Otherwise the lamp is a facsimily of Mr. Edisons Lamp. but necessarily much more expensive.

R.R. Today run around the curve and back with eight persons on the car.

Tests in Vacuum. One of the pumps was put up in photometric room and a regular paper carbon lamp attached so that when lit it would be in position to measure. At very low vacuum it was heated to 16 candles and as the vacuum increased the illuminating paper also increased to 22 candles without any increase of electro motive force and with very slight decrease in the resistance of the carbon. This test proves conclusively that high vacuo is necessary to best Economy.

The battery cells were renewed this morning and the tests today were carefully and accurately made. ~~One bast lamp~~ Book No. 42 page 117 to 173 &c.

One Bast lamp that was tested yesterday tested with old batteries and showed badly at 345 ft pounds per candle required to day with the renewed batteries 2320 ft lbs per candle.

Absentees Mr. Clarke retd tonight from Phila. reports progress at Potts and sent a lot of [illegible] Vacuum

Saturday June 26.

Power Mercury Pump. was set up in Lamp Factory. Cunningham Andrus & Schroyer there all day.

Willow Loops The Osier Willow loops carbonized yesterday were taken out this morning all broken. very delicate & tender

Bast fibre lamps. One lamp regular size bast fibre. decreased 14 ohms in its resistance after heat put on. at 40 candles low vacuum the blue was very noticeable but after high vac. was obtained the lamp was raised to 60 candles and showed no blue. the lamp when first heated at low vacuum. gave 9 candles and increased with the improved vacuum up to 20½ candles on same electro motive force the clamp remained bright after the lamp had broken. Book No 42 page 175 &c.

A second test of a similar lamp 22 3

ohms cold decreased to 95 ohms when heated to the increase in illumination as the vacuum improved was about same as in previous test.
The lamp was then raised to 64 C. in high vacuum and gave no blue although it showed blue at 44 candles in low vacuum. Tested then for economy. at 14 candles it gave 12.2 per horse power and 74.3 ft pounds per candle when at 64 candles Book 42 page 201 &c.

Ballast Ten car loads of ballast sand dumped by Penn RR for the electric Railway to day near culvert.

Chlorine Exp on carbon. Dr. Moses having found very little if any thing in the carbonized tissue paper which he had analyzed by request of Mr. Edison. He tonight placed a carbon plate in bottom of evaporating dish. covered it with a

paper carefully laid a number of sheets of the carbonized tissue together on top the paper. and connected one pole of battery to lower plate and the other to the tissue, covered the same with saturated solution of salt & water left to make chlorine and that to work upon the carbonized tissue.

Work general of work. Mr. Batchelor still absent. Ott on former for and getting out slotted plates in which to carbonize Bast fibres. Most of the men in shop on preparing the gear castings for putting on the electric locomotive. Three men during day on R.R. extension and Marley with five men from 6 o'clock till dark. Mr. Edison and Upton testing and experimenting with Bast fibre Lamps. Glass blowers on pumps.

Small pila dynamo. fed five lamps after being fitted with a pulley which runs it 2500 Rev per M. Mr. Upton says it will sufficiently eighteen lamps.

Monday June 28

Lamp Factory. Men worked all day yesterday down at Lamp Factory. Men on Rail Road.

Absentees Yesterday Mrs Edison. Upton and Clarke were to the beach. In the morning Mr. Batchelor returned from his trip after an absence of ten days. (since June 16)

Carbonization. Van Cleve carbonized a few loops of Soft porous Bast fibre which came out first class. Also some loops of Palm leaf which also came out very good. they were all put in lamps and one of each prepared for the pump in photometric room, but nothing done with them today.

Small field dynamo tested gave 90 volts. 9 Lamps were put up in Machine Shop and very brilliantly lighted by current from the little machine.

Lamp. Bast fibre lamp made with small double partition between the clamps was tested resistance hot 113 ohms at 16 candles required 192 ft lbs per candle 12 lamps per horse power. Book No 42 page 229 &c.

Chlorine exp on carbons noticed on Saturday examined this morning the carbon was found to have been effected by the chlorine, proving its impurity and presence of Hydro Carbons. The experiment was made thus by immersing two in solution of salt water card board carbons regularly clamped to sealed wires one connected to each pole of battery— the result showed the presence of Hydro Carbon same as first exp.

Visitors Prof Barker. Collins of Herald a large party of Havana. Cuba. and Bailey & Puskas in the evening.

Rail Road. run for the Cubans. Armature of new Machine again burned out. no cause could be discovered.

Lamps Tested - One soft bast fibre carbon regular size Very blue at 35 candles Book No. 42 page 251 &c continued in No 103. Another of same kind of carbon with resistance of 790 ohms cold, very blue at 44 candles and lasted about half a minute. Regular Bast Lamp resistance cold 194.4 ohms No blue in high vacuum at 40 candles. Was sealed off the ~~pump~~ in thirty five minutes after starting the pump.

Palmetto carbon resistance 115 ohms at 13 candles. put at 44 candles and sealed off after remaining at that heat for one hour. Book No. 103 pg 1 &c.

Clamp Machine. Mr. Batchelor is again down to business on the clamps machine

Electric Messenger Mr. Edison to day revived the idea of the electric messenger. and is seriously discussing the putting of it in practical operation for six or eight miles

as an experiment. and the theme this evening is a discussion of the means and appliances ~~for the~~ and superstructure for the trial. See ~~also~~ May 7. 1880

Carbonization Van Cleve carbonized some Bast fibres .005 by .012 & .010 by .010. and got out one willow .012 by .012 which was immediately put in a lamp and tested gave 232 ohms hot. quite blue at about 40 candles and lasted about five minutes. Mr. Upton says it took 71 ft pounds per candle.

Small field dynamo. The magnets of the small machine were wound with 7 additional layers of .035 wire making in all ten layers. It is running at night and furnishing the current for 8 or 10 lamps in the shop.

Visitors Mr. Edison Sen. ret'd from trip in Canada & west.

Wednesday June 30.

Lamp tests A Bast lamp .005 x .012 carbon at 19½ candles gave 280 ohms resistance and was a little blue. It was then put at 18 candles which on face of these loops is calculated to be equal to 44 candles on the regular loop. and broke in about 10 minutes. It took 2810 ft pounds or about 90.5 ft pounds per candle Book 103 page 398c.

2nd lamp same size carbon lasted 8 minutes at 18 candles and took 102 ft pounds per candle

Palmetto .012 square broke immediately on turning on the current

Calorimeter and Galvanometer test on paper carbon lamp. 87 Volts. Calorimeter 3810 ft pounds and Galvanometer 3920 ft pounds. Book 103.

Small field dynamo again taken apart and two and one half layers of .022 wire wound on magnets making now about 100 ohms of wire on them. set up and running the 9 lamps in machine shop run satisfactorily.

Capillary traction. Some question having ~~arisen~~ been raised as to the effect of the size of the gauge tubes on the reliability of the readings. Boehm made a U shaped apparatus of glass tubing one side about one eighth of an inch bore and the other side of same gauge tubing and put in about 3 inches of mercury. the mercury stood in the large tube about ¼ of an inch above that in the small tube. (showing much less difference than was expected).

Stop cock. Mr. Andrews devised and made a sketch of a simple and easily managed and constructed stop cock for use on the mercury pipes leading to the vacuum pumps. The principle is to have a rubber cylinder or valve: worked by a screw and to press squarely against the direct flow of the mercury. by conducting the mercury from the main pipes ~~at direct~~ by openings in the sides and at direct right angles with

the main pipes into a reservoir in which is worked the rubber valve or disc by the raising of which both the inflow and outflow holes are opened and by screwing the disc down nearer the bottom of reservoir the flow is diminished and when screwed down firmly the flow is stopped entirely.

New Mineral Dr. Moses claims to have discovered a new mineral in some ores sent here for assay from California as described by him, it resembles in appearance chromite but differs from it in its chemical composition and in streak

New Moulds or carbonizing furnace was devised and sketched by Mr. Batchelor. It is a nickel box of size sufficient in depth to hold 30 slotted plates. the bottom of one serving as a cover or lid for the one beneath. each entire plate in this way requiring about 1/8 of an inch. The plates are only large enough for one loop at a time. and the box or mould filled with the plates is designed to be used in a gas furnace which will be devised expressly for the purpose.

Visitors Lowery. and a friend and Mr Philips

Absentees Mr. Edison went east (probably to New York) at 11 20 and returned at 5 30 with Lowry & friend.

Thursday July 1. 80

Conductivity of fibre carbons, estimated Book 103 pge 63 &c.- Manila .005 diameter by 2.4 inches long. 505 ohms resistance cold, or 5.205 ohms per mil ~~foot~~ inch. Bast .012 by .012 square 195 ohms cold or 7.099 per mil inch. Palmetto 0.0124 .012 square 5.207 per mil inch.

Electric Messenger. Mr. Edison directed Hornig to devise and make diagram of a Motor geared expressly for speed and as light as practicable to be capable of 200 miles per hour for messenger.

Andrus at work on the superstructure of track to be carried around a circle of 1000 feet diameter to make an experiment of the utility of the invention.

Lamps. During the day, six of the lamps in the shop run by small dynamo have broken. four in the glass and two only in the carbon. The carbons remained unbroken in all those that broke in the glass.

Gas Works for Lamp factory staked out by Mr. Kruesi and Ayers commenced drawing down brick for use therein.

Armature. burned out the other day while running the railroad June 29 had the coils replaced with fresh wire and tested ready for use.

Work. All shut down at eight o'clock to give those so inclined, an opportunity to go to Menlo town to election of School directors.

Gas furnace. Mr. Batchelor is today designing and making diagram of a gas furnace for carbonizing.

Friday July 2d 1880

Pumps. The glass blower finished the two hundred of the pumps and men have today been carrying them down to Lamp Factory.

Four lamps were attached to one of the pumps today and after excellent vacuum had been obtained. Mr. E. was showing the pumps to Prof Barker and F. Thompson of Penna Rail Road when the mercury for some unaccountable reason flowed up into the lamps entirely destroying the vacuum and three of the lamps. Four others were then attached and sealed off about [illegible] two, after breaking two

Wood Miller. Dean today is trying to put his face cutting attachment for the lathe for working wood loops it is a very complicated neat piece of delicate and compact machinery but too incomplete yet for an attempt at descript[ion]

Crucibles for Assays. Cunningham finished a mould in which to press suitable material into form for the small crucibles which

are used in the final process of assaying and tried it several times with chalk it worked very nicely and he got out a few very perfect specimens. The mould is made of iron, composed of a base in the center of which is a round raised piece to form the cavity of the crucible. on top is placed a cylindrical part with hole through the center, widened near the bottom into shape of reversed or up side down funnel. plungers are fitted very snugly to ~~fill~~ the hole, or bore and after the material is placed in, the plungers are ~~placed~~ inserted and pressed down in the bore. the base and cylinder ~~being~~ separate but neatly fitted together and the one lifted from the other easily the crucible to be easily removed.

R. R. Station Martin Force removed the platform from the end of Rail Road Station & changed the wire connections to one side of the building preparatory to remove the end of station for continuation of road.

276

Magnetic Separator. design for the practical working of the magnetic separator was completed and sketch of the same given to Mott from which to make Patent Office drawings. capacity and specifications in Book No. 80. page 200 & 201.

Lamps & Magnetic I find in Mr Uptons Book No 103 on page 275 quite a descriptive list of experiments requested by Mr. Edison to be made on platina wires in air and vacuum, also ~~on the~~ to determine whether an active armature contains any magnetism. and some others.

Loops. None but regulars have been carbonized today. but Bradley has gotten out some more of the Palmetto loops and was directed by Mr. Edison to cut, on the same former used for bast, some out of manila glazed card board and also try rye straw some of which I got for him.

Visitors. Mr. Willer, also a Mine Prospector of Leadville Col.

Drawn! Wilson & Clarke Started for 4th July trip

Saturday July 3. 80 277

Journals of Armatures. Cunningham to day has been turning out the inside of the brass boxes of Armature bearings and running in them Babbit Metal.

Ore. A package received this morning from Rock. Mass. and by Mr Edison was found to contain gold. the first he has found in Massachusetts ground.

Pump. One of the pumps was taken out and the connection between the Sprengle drop tube and the gauge tube was made small and crooked (to prevent if possible the up flow of the tall mercury into the gauge tube and lamp) for experimenting on testing for leakage or lowering from any cause of the vacuum

R.R. Station The end ~~boxes~~ taken out of the Station in preparation of extending the track and doing away with the bumpers.

Magnetic brake. Logan put brake wheels on the axles of one of the cars and turned

And polished them preparatory to putting on the complete brake

Locomotive, ~~Large~~ Electric for ~~heavy rail roading~~ was roughly sketched by Mr. Edison. The Armature is ~~sleeved~~ made on a sleave over the driving axle and secured thereto by clutches. I should judge the purpose to be to get high speed with very simple gear.

Pullman Palace Car was put on track thro Old room.

Rail pattern. Andrus ~~is~~ making the pattern for the elevated messenger road (the cross section of the rail would pretty well represent a capital Z round. 5)

Drawings. Magnetic brake applied to Ordinary Rail Road car were made by Mr. Edison and given Mott from which to make P.O. drawings

Carbonization. ~~New~~ carbon was dipped in a solution of Ammonium Salts & Valentine and one in Chloride in Alcohol and after drying were recarbonized and came out very nice.

Work general of week. Mr. Jackson Ott & Crew on lamp machine. Mr. Edison & Upton, testing lamps and experimenting on carbons. Pump power put up in lamp Factory. Men on R.R. extension. Several in shop on gear of Electric Locomotive. Glass Blowers on pumps. Carpenters on Cars & Elevated messenger rep.

 Wednesday July 7. 80

Note On my return this morning to my post of duty after an absence since Saturday afternoon, I find.

Brake and Light } Sketch by Mr. Edison of the arrangement
Application } and application of electricity to the brake and lighting of Locomotives and ordinary Rail Road cars. The dynamo for current to both brakes & lights is secured in front of Locomotive over the cow-catcher, and the current controlled by line-switches managed by the Engineer from the engine cab. ~~The current~~ ~~is~~ Also

Carbonizing Moulds } were sketched by him ~~Lathe~~
& Fiber tools } of which were given to Mott from which to make Patent office drawings.

Electric Canal } And I find in Mr. Kruesi's
Systems } office Sketches of two systems of operating canals by Electricity. One consists of carrying the current along the canal by suitable conductors from which the current is carried to motor, on board of boat, which ~~operates~~ drives a screw propelling wheel. The other is for track laid along the tow path over which a ~~car~~ motor with hand-over hand clutch gear travels and by line or otherwise and tows the boat or boats

Applications } I find in Mr. Edison's Book 108
to be made } page 3 &c. A list of applications to be made of the system for power, lighting &c. both for land and submarine purposes where light or power or both may be used. and

Left. That on Monday Crosby and Lawson left for the west

Armatures. Two were slightly damaged yesterday by a cross. and heat

Foundation Men had commenced digging for the foundation, for the Porter Engine. alongside the boiler room

Wednesday July 7-80

Slotted Plates. John Ott made a couple large slotted plates to hold six inch fibre and I am below carbonized two of that length, in the new plates and new long straight moulds, that have lately been received. The carbons came out very nicely.

Fire brick. Are being drawn by Ayers for the arrangement for burning coal dust under the boiler.

Fibres. A collection of Bamboo, Reed and Choice Bast have been obtained and some loops cut out but none yet put in the lamps to test.

Vacuum test. In pursuance of trial of vacuum mentioned under July 3. A lamp was sealed direct to the pump and after good vacuum the pump was sealed apart at tube connecting the drop with gauge tube, and lamp allowed to remain burning for a long time: no fall could be observed for some time, but finally a small bubble of air was let or leaked in and vacuum dropped accordingly, but ~~very~~ immediately began to improve again, without working the pump, showing that the air was either absorbed or used up in the oxidizing the carbon. (part of the above added to note of July 3)

Working drawings. Mr Edison has Hornig or at least requested him to make working drawings of the applications of the current for light and power as per list on page 3 of Book 108 mentioned under Notes of work during my absence (preceding)

Magnetic Brake. The box or Pullman car was painted, raised up or blocking, preparatory to putting on the magnets for brake, which Smith is preparing, and has nearly ready for their uses

Multiple Arc. One of the armatures burned yesterday was repaired and set up again. Machines connected in multiple arc, but did not [illegible] them brown enough to burn them up. Armature connection in series they carried to give better [illegible]

[illegible] 120 lamps [illegible]

Thursday July 8.

Sparker & Lamp. Mr. Edison sketched on page 145 Book 68 a lamp with spark tube attached for the purpose of further observations on the loss of vacuum. One sealed off the pump last night and was tested to day. The sparker was connected with the condenser and two batteries. and the lamp on the Dynamo current. According to the color in the sparker, the vacuum lost some. Book No. 104 page 10 &c.

Mr Edison directed Francis to have the sparkers made of 036 platinum wire in place of heavy long aluminium.

Fish plates. Mart Force went over the track of Tramway to day and tightened up all the fish plates. and down at the top of the hill removed one from each rail. to break the connection and save the loss occasioned by fresh dirt &c. being thrown on the rails below where the men are at work on the extension.

Long Bast. Two lamps of six inch Bast fibres were made to day and tested. the first tested 200 ohms resistance. 8 per horse power at 16 candles. set at 44 candles showed no blue and lasted twenty minutes. Second one 147 ohms resistance less economical And blue at 44 candles burned forty minutes when engine stopped. Book 104 page 18 &c.

Poles. Two very long poles were delivered on the ground and one of them raised at the lamp factory for the wires for power and telephone.

Brake Magnets. The magnets for the Magnetic Brake were wound with six layers of 0.032 wire and the Power run till twelve o'clock to finish them up ready for putting on in the morning.

Visitors. McMahon, and McLaughlin with three California friends, also Mr. Wilber a short time.

286 Friday July 9.

Papers. Scientific American date July 17 contains a cut and description of Edison's Magnetic Blast separator. Also cost of maintaining horse power per hour from experiments and observations made by Brisinger. Steam engine 100 horse power 7.6 per horse power per hour. Same 2 h.p. 44 5 do. Lehmann's Caloric Eng. 2 h.p. 26.5 do and Otto Gas Eng. 2 h.p. 26.4 per horse power per hour.

Screw Gear was set running in the lathe to scour the cog bearings.

6 in Carbons. The lamp which remained burning when the engine stopped at twelve o'clock last night was broken this morning by having the electro-motive force run up, in attempting to set it again at 44 candles.

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A second lamp was exhausted on the pump and tested. 275 ohms cold. 174 ohms hot at 16 candles and gave 6.9 per horse power. Set at 44 candles it lasted about one hour.

Wood Miller. Dean is running the four face cutting tools of new ~~wood~~ loop miller, from one counter shaft which ~~being~~ hinged having the bearings hinged and being weighted acts also as a tightener and allows of the carriage in which the cutters are secured, to be moved backwards and forward without any strain on the belts. He did not try it practically to day but merely run for awhile to wear and polish the bearings.

Captive Baloon. Mr. Batchelor made an apparatus to experiment on an Electric Captive Baloon. An upright pair of

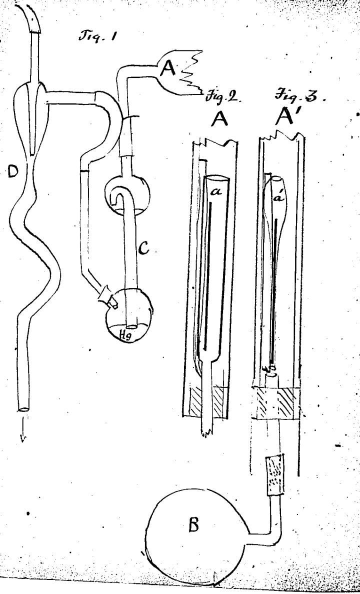
Magneto are used and the moto[r]
armature made to revolve betw[een]
the poles parallel with them o[n]
shaft extending above and o[n]
the end of which is a wheel ab[out]
ten inches in diameter made l[ike]
and on same principle of larg[e]
wind mills. the current being
turned on the, motor causes the
wheel to revolve rapidly and b[y]
the action of the slanted tin fan[s]
against the air gives it the tenden[cy]
to rise, but in the trial to night the
tendency would not overcome the w[eight]
Sketch by Edison Book No 118 pg 142
Magnetic Brake. was completed and
with the new car. the car run [?]
and heated by one trip down a[nd]
back. I judge the brake did [not]
give entire satisfaction as I cou[ld get]
no information about it and knew
when the trial was made. could not
[illegible]

Menlo Park Notebook #55 [N-80-01-28]

This notebook covers the period January-June 1880. The entries are by Edison's chemist, Otto Moses, and relate to the chemical treatment of carbon filaments. There is also one entry relating to gold ore separation experiments. The book contains 21 numbered pages followed by approximately 200 unnumbered pages only a few of which were used.

Blank pages not filmed: 12-15.

Fig. 1 Fig. 2 Fig. 3



Carbon (1.)

It is proposed to try the reducing effect of various gases on paper at different temperatures, principally the hydrocarbons.
The apparatus consists of A combustion-furnace supplied with vaporized gasoline mixed with air; B a little retort of thin glass holding about C.C. a safety tube C and a vacuum pump. D

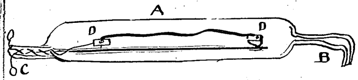
Bi-sulphide of Carbon. CS^2

The paper to be experimented upon was bristol board

cut in strips about length and thick.
It was enclosed in a lead glass tube drawn out and contained in a hard glass combustion tube (bohemian).
The CS^2 was passed over rapidly; the heat was dark red and was kept up five minutes.
- Paper was carbonized blackish gray.

Tube A covered on inside with carbonaceous deposit adherent to glass.
A liquid collected at cool end of combustion tube.
Copper became covered on under side with red oxide and on upper side with black [illegible]

Fig. 4.



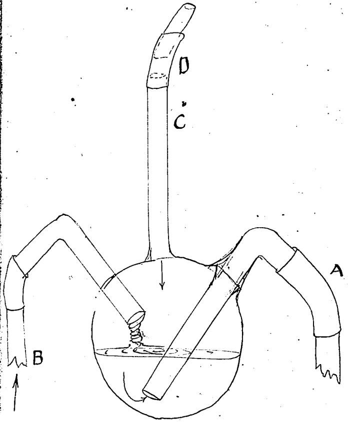
Insulated Wire. (2,

Proposed to insulate wire with glass. for purpose of getting resistance tube to test carbons in vacuum and to drive off the heavy carbonaceous product which permeates the mass of the charred paper. This may be Bitumene, which does not vaporize at dull red.

Found insulated spools of Copper wire could be made. for electrical purposes. Fig 4.
A is tube to be applied to vacuum pump.
B neck for closing. C. Twisted platinum wires insulated with spun glass tube, and melted in. D clamps for E carbons.

Carbon. (3,

Same conditions as above (1), with exception of longer heating - ½ hour and corresponding slow volatilization of the CS_2.
A bright crystalline deposite along edge of copper - probably CuS Chalcocite?
Under microscope there appears to be among the black metallic lustrous crystals an octohedral transparent one now and then probably caused by reflected light from adjoining individuals. A' Fig. 3.
- Paper carbonizes blackish grey.



Carbon (4)

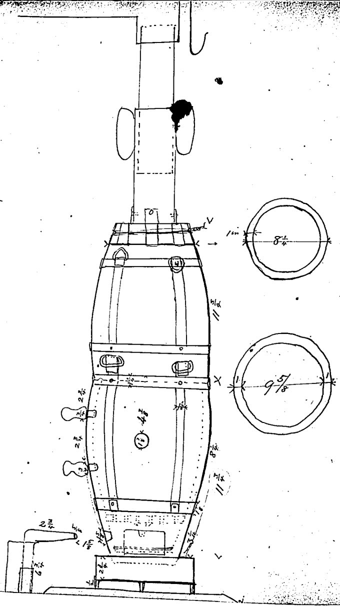
Benzine. (C_6H_6)

The gas goes over slowly and then condenses so rapidly as to create a more perfect vacuum than the pump. drawing in the combustion tube so as to compress the tube holding paper.
Paper carbonizes blackish grey.
Tube covered with denser coat of carbon than in (1) and (3).

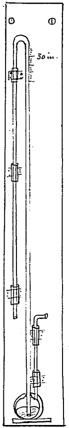
The return of the condensed fluids in C, Fig. 2 only prevented by pinching. These are darker in color than C_6H_6.

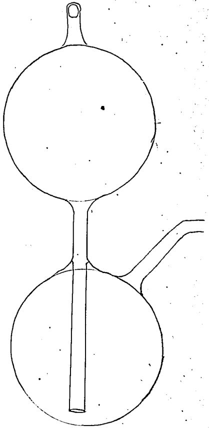
Siphon for acids, &c.

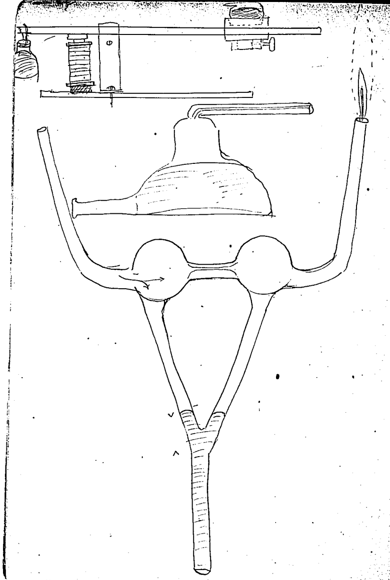
Pinch A, after immersing B in fluid to be drawn off - and suck through C till the foot of A is well covered with liquid. Blow then through C. then pinch D and insert the plug. The longer leg A of the siphon then runs the fluid into a receptacle.

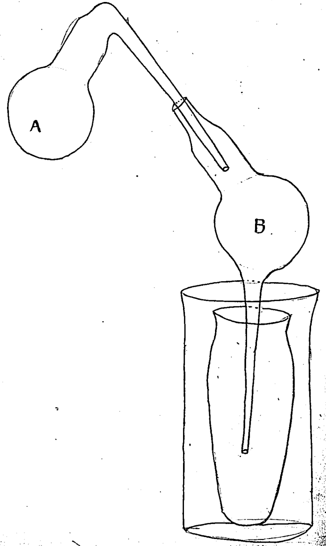


Furnace, blast, for combustion. (6)


30 in.







Hydrocarbons.

After a certain time electric lamps become coated on the inner side of the glass, with a dark brown translucent coating that resists removal in.

It is proposed to isolate it.

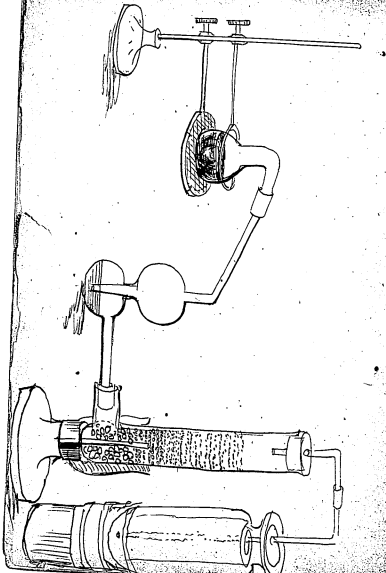
Ether seems to dissolve it; and it is then precipitated by evaporating the solvent to near dryness.

Test the ether itself to see whether it does not give the same result alone: the product may be the result of oxidation of the ether.

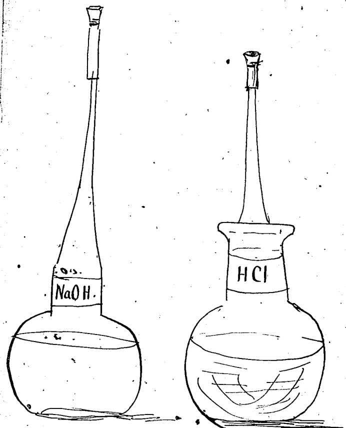
Following apparatus employed.

A holds about 150 C.C. B is similar vessel

20 C.C. Sulphuric ether was introduced and evaporated keeping the neck of A, and the bulb of B cool. (50 p.c. of ether easily recovered.) A slight opalescence of the residue. This experiment thrice more repeated, a very decided clouding of the 2 or 3 C.C. remaining.



Arsenical Ore. for Gold.



Feb. 20.

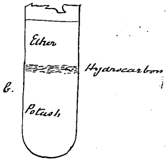
Hydrocarbons.

It is proposed to make a series of experiments with different solvents on the coating referred to p. 17.

Chlorine dis^d in Water.

The water was the residue after passing gas through it made from MnO^2 + 40 gr. HCl + 10 gr SO^3HO + 10 gr HO. It consequently contains HCl diss^d.

(1) Weight of Bulb No. 671 clean and dry + wire ...	23,358
" after treatment for ½ hour washing + drying ...	23,356
Loss	,002
(2) Weight of Bulb No 669 &c ...	24,515.5
" after treatment	24,513.5
	,002



Feb. 26.

Hydrocarbon.

Cl. diss^{d}. in Water

Weight of Bulb No. 673...

March 1st.

Potash (concentrated),

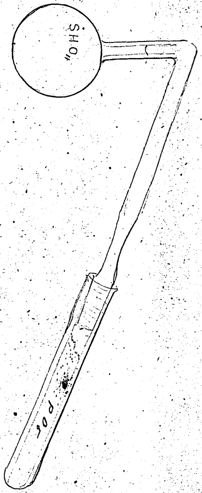
Bulb No. 670 (flat) boil for 30 min.
Blackish pellicle settles easily in masses but
a. broken up floats long time suspended. Sulp. Ether
b. added it separates as in Fig; boil & opalesces then clears

Soda (concentrated) 672

Potash (concentrated).
Bulb No 673.

Soda (concentrated,
Bulb No. 715:
Seems to loosen very easily in 10 minutes.
Decant, wash, evaporate nearly to dryness.

treat with $CHCl_3$. does not affect it on heating, though it seems to break up more thoroughly ... Treated with $(C_2H_5)_2O$ seems to condense it. It sticks now to dish .. Dissolves slightly (?) ... C_2H_5OH.

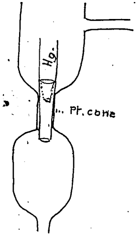


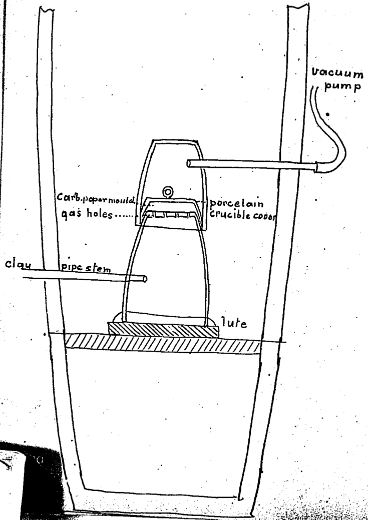
Hygroscopic capacity:

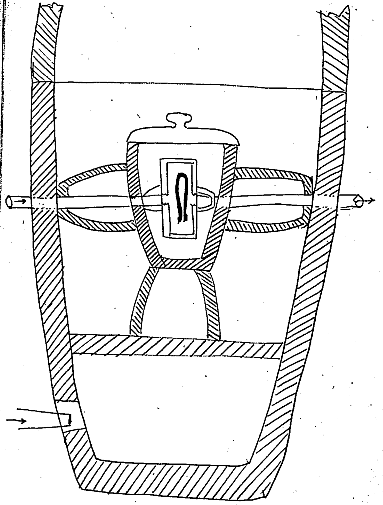
Doubt as to the advantages being really actual accompanying the use of Sulph Acid having been expressed; it is proposed to test the relative capacity of it and PO_5-anhydrous see fig.

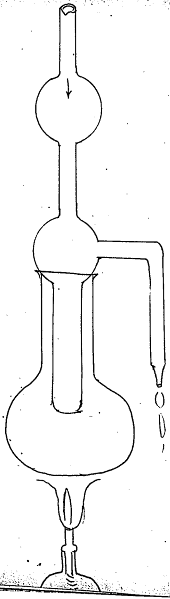
At 2.30 P.M.

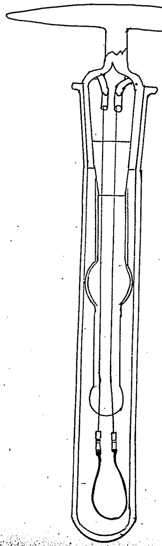
Weight of bulb + SO_4H + loop Pt + stopper } 49.163

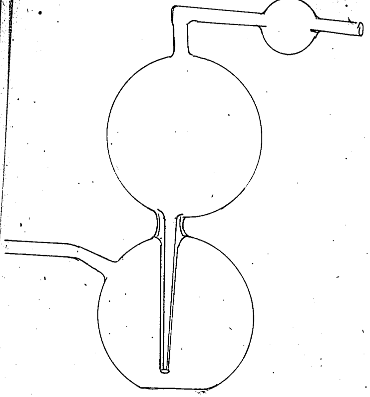

Hg.
Pt. cone

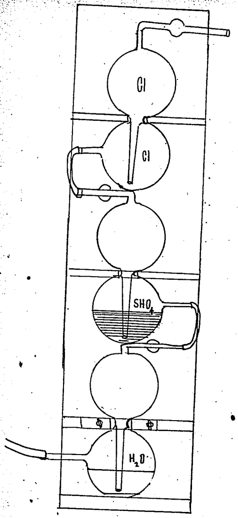

vacuum pump
Carb. paper mould
gas holes
porcelain crucible cover
clay pipe stem
lute



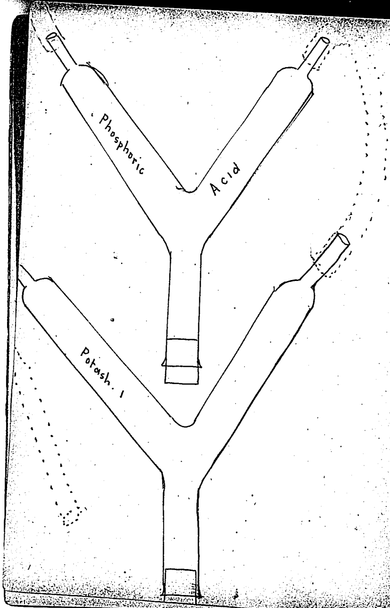


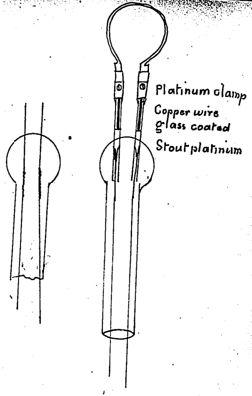


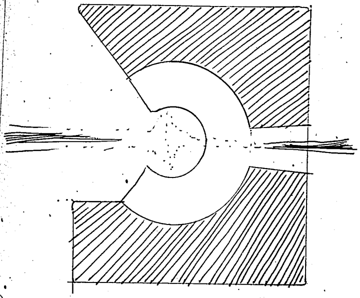


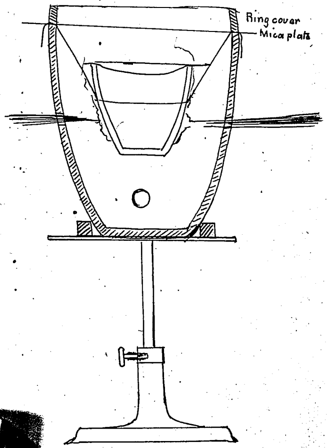


Cl
Cl
SHO_4
H_2O

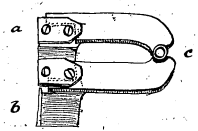

Phosphoric
Acid
Potash. 1

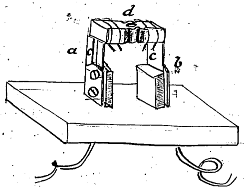

Platinum clamp
Copper wire
glass coated
Stout platinum





Ring cover
Mica plate





Reduction of Oxides.

Mr. Edison proposes to reduce to metallic form Al_2O_3 by reduction in a stick of incandescent Carbon, heated by passage of the electric current: the experiment to be conducted in vacuo

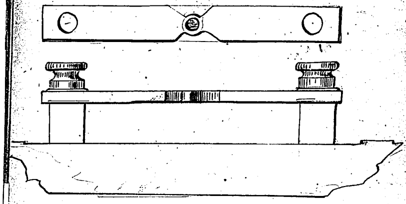
The apparatus consists of an air pump whose plate is covered by a supplementary heavy disc of cast iron with slight annular projection fitted on the air-pump plate. There is an opening in the direction of its height which allows of the passage of air to to the pump. The upper part of this disc is ground to receive the bell glass

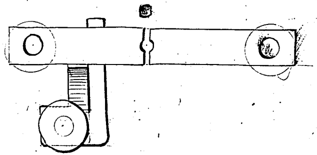
Electrical connection is made by means of two binding posts, one insulated, the other inserted direct into the iron plate.

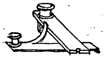
The current is made to pass under high resistance at cup **C** which contains the oxide to be reduced.

This form of apparatus is not durable, difficult to be made and liable to make bad contacts.

The same is the case as far as the making of contact with Fig.   The platinum plates fused





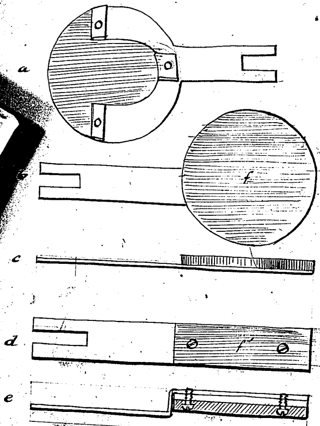


Reduction of Oxides

Fig. is even more fragile than the preceding forms. Finding, however, that when fractured good contacts could be made by pressing the ends firmly together, the apparatus was modified so as to make the carbon plate discontinuous, and to allow of inserting small carbon crucibles to hold the assay.

The crucibles are made of box wood and then are carbonized like loops... Charcoal, retort coal, Wallace pencils, and battery coal do not answer, each kind being open to objection, either too good, or too poor conductor, or too hard &c.

As the current increases, the residual air in the pump (which is seldom exhausted to less than 27.7 in.) oxidizes the carbon clamps at the points of contact; so much so that it has not been possible to pass through the crucible as much current as it is thought would be required to reduce Al_2O_3 in presence of C. To obviate this difficulty, a spring is inserted into the bed plate and held by thumbscrew, which will keep the carbon plate, against whose edge it rests, pressed up close against the incandescent crucible.



Reduction of Oxides.

Crucibles have been made of box wood and White thorn: the latter seem good but conduct the heat rather irregularly. Boxwood ones about 7/8 in. in diameter were turned in lathe to thickness of $\frac{8}{1000}$ @ $\frac{1}{100}$ of an inch. When carbonized these warped very much unfitting them for use. The smaller ones answer well, although they all seemed to 'oxydize' in the process. They should be weighted.

The apparatus on preceding page crushes in the sides of all the crucibles when softened by incandescence so the change to a form where the pressure is verticle was necessary.

a is a disc of battery carbon $\frac{3}{16}$ in thick, screwed on to a circular forked sheet of spring brass.

d is a strip of spring brass which has a piece of battery carbon screwed to it for about ~~three~~ half its length.

To both of these brass plates a spring is given in such a way as to bring a parallel surface of pressure on the parallel top and bottom of the carbon crucible which is inserted between them at point f. and f'.

Menlo Park Notebook #56 [N-79-07-25]

This notebook covers the period July 1879-August 1880. The first part of the book contains entries by Edison, Charles Batchelor, John Kruesi, and Francis Upton and relates primarily to electric lighting. Included are drawings of lamp regulators and clamps; calculations and drawings of generators; notes, tables, and drawings of conductors; and calculations about electric power distribution. There is also a memorandum by Edison on the cost of telephone parts. The second part of the book contains memoranda by Kruesi concerning material to be ordered for the extension of the machine shop and material required for generators. There are also notes on the Porter steam engine and a map of Menlo Park containing a plan for the placement of electric lights. The book contains 284 numbered pages.

Blank pages not filmed: 32-33, 68-69, 72-83, 86-105, 132-135, 144-153, 162-165, 190-191, 200-201, 232-235, 252-253, 260-263, 266-279.

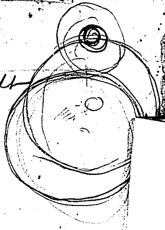
Missing page numbers: 118-120.

No 56

24 inch pullys
2 1/2 inches shaft

5
~~70~~ X 900
~~24~~ 75
~~10~~ 3 5
375

2.5 X 375 = 40XX
9
225



10

3.14
10
31.40
31.40

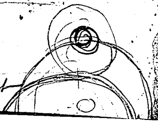
48

118
3.14
118

.031
48
248
124
1488.

Mo56

24 inch pulleys
2½ inches shaft



1

10

3.14
10
3.140
31140

48

.031
48
248
124
1488.

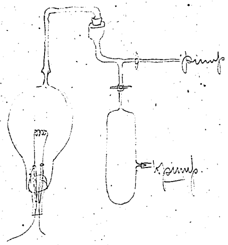
118
3.14
118
~~118~~
~~314~~
~~314~~
314
370.52

1(?)
35
955

1246
(6) 1541 . 5 - 7
128
61

July 23th 1879

C. Batchelor

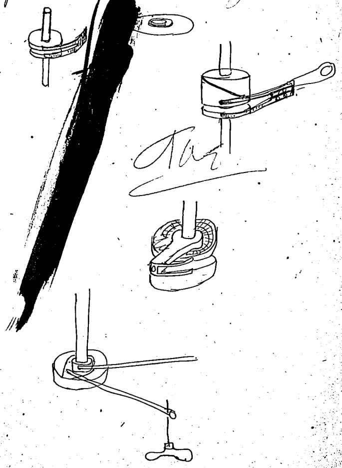


Electric Light

July 31st 1879

Lamp regulator

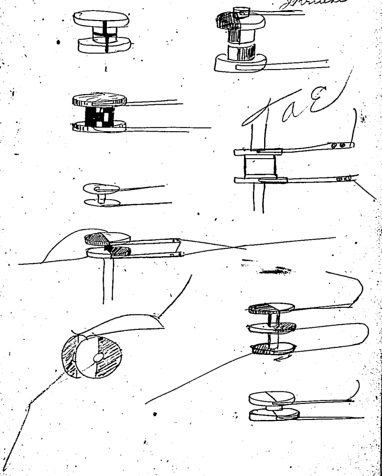
Chas Batchelor
J Kruesi

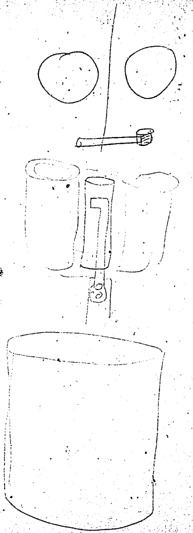


Electric Light

July 31st 1879

Chas Batchelor
J Kruesi

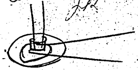




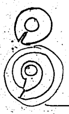
Regulator

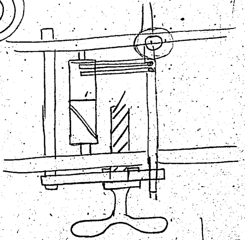
July 31st 1879

Chas Batchelor

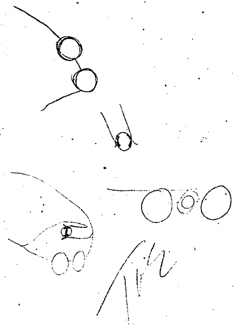


TAE





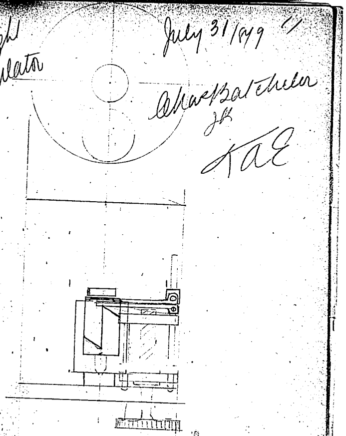
10



TAE [?]

Ee Light
Regulator

July 31/1879 11

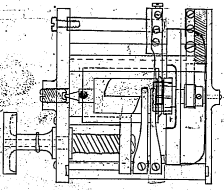


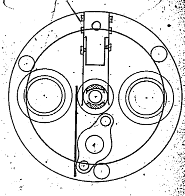
Chas Batchelor
JK
TAE

Electric Light
Regulator

July 31st 1879
Chas Batchelor
J Kruesi

T A E



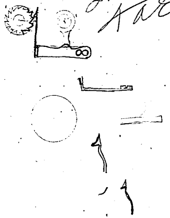


14

E. Light
Regulator

July 31st 1879 — 15 —

Chas Batchelor
J. K.
T A E



Electric Light

Sept 24th 1879

TAE

Chas Batchelor

Make 1 brass Spool.

Heads-diam $\frac{3}{16}$

Body-diam — $\frac{1}{8}$

Body length $\frac{1}{4}$

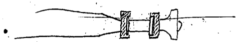
Heads length $\frac{1}{64}$

Hole through $\frac{1}{16}$

2 Holes for wires one at each end one close to barrel & other as high up as possible .007

Make 6 Lime ones —

Make 6 Alumina ones.—

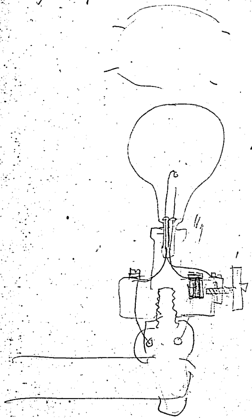


18

$2\overline{)78}$
$\quad 39$

19

$2\overline{)39}$
$\quad 19\tfrac{1}{2}$



TAE

36

.6 2 $2\frac{}{2}$
4 $1\frac{1}{4}$
100 1 8 3/8
200 50
400 25 16 5/16
800 $12\frac{1}{2}$
$6\frac{1}{4}$ 32 5/32
1600
3200 $3\frac{1}{8}$ 64 11/100 $\frac{1}{2}$
80/100
128
4/100
256 100/200

20)100
5

2 50
4 25
8 $12\frac{1}{2}$
16 $6\frac{1}{4}$
20 20

2 200
4,400

130 - $3\frac{1}{2}$
130
130
390
1.30 0
17.0 4 4
6 8 1 2 0
6.8 1 2 0
5) 7 4 9 3 2
14 9 8 - 6.4 (45 4
33) 1 4 9
1 3 2
1 7 8
1 6 5 6
1 3 2 4 4

22

8

3,c 10 Rows, 1 6urm

3 3/4 - 29,000 00

650,000.

675
4000

2,700,000 60.

75. 60.

4000 45.

13,000,600

20

3000
12,000

100,

200000000000
6000000000

1-2

60 120
20 - 90

27 - 120
90
3
270

60,
20,

Twice the number of coils
resistance same .60
make commutator 1½ ins
larger in Diameter
For Faradic machine
No 4

Oct 31st 1879

J Kruesi

800

$$\frac{5334 \times 22}{3150 \times 2.1} = W$$

```
 3150
  2.1
 3150
6300
6615.0
```

```
 5334
   22
10668
10668
6615)117348(17.7
      6615
      51190
      46305
       48850
```

17.7 inches to carry
22 Horse power

1000

$\frac{1}{10}$

$$\frac{5334 \times X}{2500 \times 1.2} = \cancel{10}\ 5$$

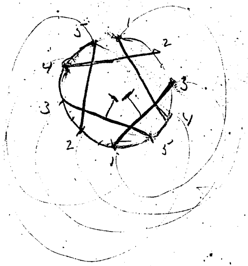
$$X = \frac{2500 \times 1.2 \times 5}{5334}$$

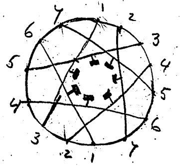
2500
6

5334) 15000 (2.8
11668
43320

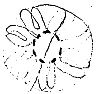
٢٣٤٣

2500
55
12500
125
33) 137,500 (

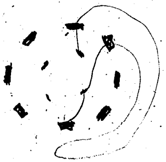

5
1
2
4
3
3
4
2
1
5


7
1
2
6
3
5
4
4
5
6
3
2
1
7

80



81



3(

0.08 19 6) 1140

3
12) 180 = 15

311
27

2526
623
80 71.06 115 12) 71.06
110
306

2 Large wheel
10 Pinion large
60 " small
75 Counter shaft

16
60
12) 960 80
18
640
185) 1440 8
1480 185 185

31

75
12
150
185) 7.00 5 12

2

75 75
23 23
18 225
184 75 150
13 13 185) 1725 = 9
414 600 1665
75
185) 1350 7
1275
75
375 2475
525 10
5625 24750
44
22500
22500 (2750
90) 2475
180
675
630
450
450
000
500

2750
10
27500

75
75
375
525
5625
44
22500
22500
100) 24750.0

$2\dot{8}16_{10}$

80
80
6400
44
25600
25600
100) 281600 (2816
200
816
800
160
100
600
600

125
.125
625
250
125
15625
44
62500
62500
687500

200) 687500 (3437
600
875
800
750
600
1500
1400
100

38

16.

1 3000
100

30

3000) 50000 (16
18000

3

8120

39

83 Vatts 100
114 200

120
120
120
240
120
14520
44
58080
58080 (3194
200) 63888
600
388
200
1888
1800
880
800

160

115
115
575
115
115
13225
44
52900
52900 (2990
200) 58199
400
1819
1800
1900
1800
100

2990
200
598000

115

365
250
365
1825
730
91,61

91.615
50
45,807.50

25 5600
30
1,6800.0

16800.00

1400 1400 1400 1400

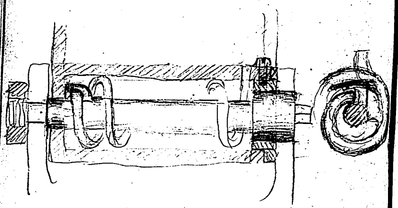
55.

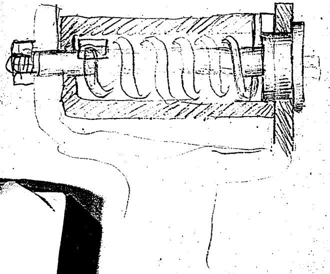
50 .112
7. 33
8. at 14 feet. 32. 6.
980
230
279.00
9

10 / 279. (27
27
9.

279.
26.90.

27
10000
270,000
29 cents.
540,000.
540000
10000
27.
42
9½





3 inch bore for rubber 55c per foot
" " " pipe 50c per foot

484
10
4840

18) 350 (19
18
170

19
25
95
38
47.5

105

475

1

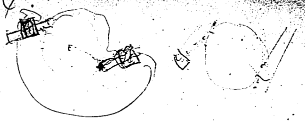
2800

27

91

350

3/4



10

1764
24
7056
3528
42336

975
975
20475
2400
64.25
75
32125
44975
12) 4818.75

401)3985

24)401.73 = 16.83
161
144
197
192
5

401.73 ft

1706)683
.10.1

0.09

1683)17060
1683
2300
1683
7190

.0.09

170.6 401.73 = 2

16.83

16.83

170.6)16830
15354
1476

9 lbs per lb
3
27 lbs per H.P.
1 Gallon 10 lbs

2.7 Gallons per H.P. per hour

2.7)100(37.
81
190
189

18.5 ~~H.P.~~ per hour
for 1 ct for H_2O at
2 cts per 100 gals

212
60
152
772
304
1064
1064
33000 | 117344 (3
44 000

7) 12,000.000

117)344) 12000000 (102
117344
265600

70.2

12.1 lbs

64°7 feed water

to raise feed water 110.000 ft lbs

12.1
121
1,331,000

9,247788
1331 000
10578,788

990
772
1980
6930
6930
764,280
12.1
764280
1528560
764280
9,247,768.0
~~46 000~~

ft lbs ~~9,357,~~788

1178
772
2356
8246
8246
909416
121
909416
1818832
909416
11,003,933.6

772

966
772
1932
5762
5762
63575
121
635752
1271504
635752
7692591

110,000 ft' lbs to heat 1 lb

11~~0,000~~) 769.2~~500~~ (
70 lbs of H_2O

212
122° F
90° F

774
90
69,660

69) 110 (1.6
69
410

33000
60
1,980,000

69,660) 1,980,000 (28
139320
596800

52

~~240~~

28 4 × 4 16 ft [illegible]
16 2 × 4 B " "
80 10" 13 ft [illegible]

14 6 × 8

Boxes for Ground Conductors

~~Number of Box~~	Numb strands	feet
1	1	126
2	2	366
1	3	366
1	1	320
1	3	329
1	2	286
1	1	160
1	1	260
1	1	320
1	1	320
1	1	240
1	8	366
1	18	404
1	16	446
1	10	366
1	5	320
1	1	276
1	1	276
1	18	320
1	11	412
1	10	130

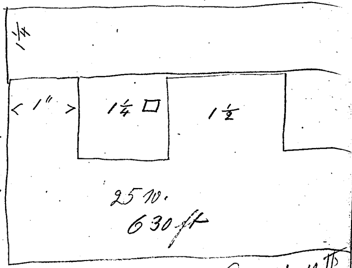
1	1	276
1	1	276
1	1	240
1	1	380
1	1	240
1	2	320
1	3	320
1	4	320
1	5	660
1	3	484
1	2	484
1	1	268
1	1	240
1	2	240
1	3	320
1	4	320
1	5	320
1	6	240
1	7	372
1	8	443
1	3	572
1	2	364

/	1	302
/	2	240
/	3	320
/	4	400
/	5	480
/	6	160
/	7	240
/	25	620
/	6	520
/	5	520
/	4	244
/	2	240
/	3	160
/	4	320
	5	400
	6	320
	7	160
	8	240
	1	620
	5	660
	4	532

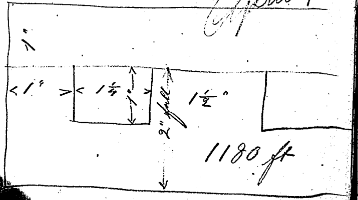
/	1	160
/	2	240
	3	240
	4	240
	5	320
	6	160
	8	80
	9	480
	1	620
	1	393
	2	258
	4	266
	3	354
	2	305
	1	265
	3	620
	2	394
	1	122

25 Strands 630 ft

18816 " 1180 "



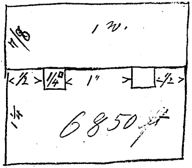
April 13th



1 Strand ft

630) 16400 25
1260
3800

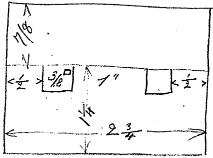
126
320
160
260
320
320
240
276
276
276
276
240
380
240
484
268
302
620
160
620
393
265
114
6839 ft
11
6850 "



April 13th

2 Strands ft

3750



3 Strands 4085 ft.

same as above

total 7850 ft.

On hand 2000

ad. order 5850 ft

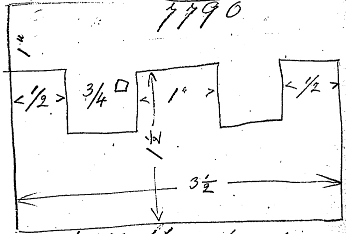
Apr 13th

4 Strands 2642 ft

5 " 3730 "

6 " 1400 "

7772
18
7790



7000 ft on hand

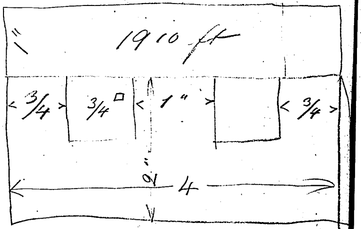
ad. order 790 ft

April 13th

7 Strands 777 ft
8 " 1129

1906
4

1910

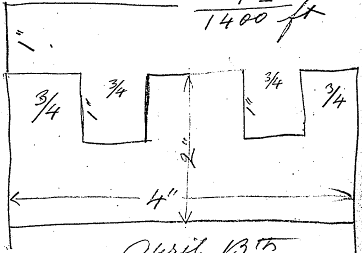


April 13th

9 Strands 480 ft
10 " 496 "
11 " 412

1388
12

1400 ft



April 13th

64

Cr of Sargent $1601.00

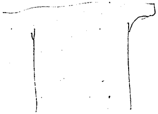
630
1180
1810) 16000
1448
152

18.00

Total No of ft.

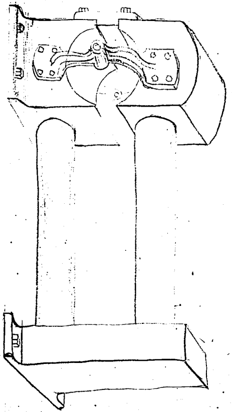
630
1180
6850
7850
7790
1900
1400
27600

66



67

Apl. 23, 1880



March 26 1880,

TAE

5 Layers of No 12 wire
on each magnet
Diameter .109. Covering about .025.
730 lbs of bare

order wire in 5 spools 750 lbs
20340 ft.

Bell	125.
Box	55
Case	70 - 10 cents
Trans.	1.00
Springs.	10
Screws fasten box	3
6 Binding P.	
arm.	1.25.
Bridge.	10
Dia-plate-chk. R.	.90
Rubber tubg.	10
Coil	2.00
Keys.	30.
Assembling	40.
Stock.	40
Screws	60
	958.

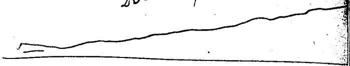
drop Cost 18c

365
300.
109,500,000

365
250
365
1825
18,615

Bell 1.05.
Box .55
Case 70
Trans

250 400



365 46-
250
365 $3\frac{40}{}$
1825 Portland 56
730 65= $3\frac{40}{100}$
91,615
2 5000000000000
183230 50.
Portland 81000 53000
201230 839 56000
Portland 89330 500000
4500000000000
103,

4

108

2
2
5
3
5
3
8
8
5
5
3
2
5
8
5
5

64.

50.

119

Trans

Oftutnia, 45.

Transmitter

Case castings.	8	cents.
Screw at batton platinized	11	
Top screw. button	11	
Boxwood.	4	
Platina.	45	
Connection & screws.	4	
diaphragm.	4	
screw & washer in diaphragm.	6	
Turning inside of Trans. [illegible]	20	
Drilling & Tapping	5	
Screws.	4	
Carbon button	10	
	133	
Japanned.	2	
	135.	

175

washer $1\frac{1}{2}$
" 1
screw 2
punchdrop $1\frac{1}{2}$
Soldering
nut -

Turning	5.
drilling	3
tapping	1
plating	~~1~~2
tapewashers	1
Drilling	~~4~~
	23.

Receiver

Case	60.
10 Bushings.	18 ~~15~~
2 Connection screws on edge.	$2\frac{1}{2}$
Large Screws.	~~7~~
Diaphragm: Drilled cut	~~8~~ $2\frac{1}{2}$
6 = Screw for screwing on dia, blued	9
Square connection piece on edge	1
Pin in big screws.	1
nut-screw head. - spring, washer, Palladium. soldering. wire connection	$17\frac{1}{2}$
Chalk Button	
Brass Barrell. castings	2
washers	4
~~Screw~~	~~1~~
work in Barrell, plating, drilling tapping turning & everything platina,	25
Bridge	10
Stock,	5
Rod. with pin in it.	3
tube,	5
Shaft.	1
worm	$1\frac{1}{2}$
Screw in bridge	$2\ 1\frac{1}{4}$
Screws in end worm shaft.	2
Worm cutting.	2
Stock on shafts.	2
Rubber damper	2
 piece for holding worm.	9
Worm. (steel)	15
Handle & button blued	$16\frac{1}{2}$
arm - Castings	12

114

Screws Brass & Mac',	3
Washer', hardened	1 1/2
work on washer pins etc	4
Large Screw for arm; blued,	1 3/4
Turning arm & bracket. drilling milling	20
Pin	1/2
Drilling all holes, 19 holes	10 c
Bridge, Gravelight, Milling, drilling, Cap. assembling & getting worm movement working	25
Japanning.	6
Rubber tube,	4 1/2
assembling, paper work	
3 wood Screws,	10,
	$3.25.

17

325.

118

Coil.	2.00
Wood box & Base.	.55
Springs.	5
two square brass connections.	.5
2 wood screws for fastening box.	1
Cutting connections drilling base - Sawing slots out box.	15
6. Binding posts	36.
nuts	.6.
12 washers,	2
2. Key buttons,	10.
2 Key buttons	6.
2 Key button screws.	3.
platina points,	.9
Key lever - stock & drilling.	6
bridges drilling	
Soldering	.6.
8 wood screws for keys.	2
Connection wire.	5
4 screws fasten teleph.	3
Running wires assembling.	25
	400

8

Packing for Eng 25c

116

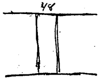
~~49~~
.860

No. 18 wire
.049

16) 1.00 (6.25
96
40
32
80

100
625
93.75

.060) 937.5
156.3



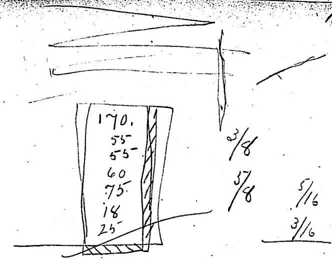
15 wires
5
12) 75 Turns
6.25
2
12.4

5 layers

232.5 feet an Ohm

3/16
: 5/16

117



170.
55
55
60
75
18
25

3/8
3/8
5/16
3/16

1 inch
8/16
9817
0490
1.0307 inch

3/16
5/16

5/32 + 3/16 =
6/32 = 11/32

6,25
3.125
11
3125
3125
34375

625
5
3125

625
16
3750
625
10000

Ms
80.000
60
480000

46
64.000.000 Ms
90 000 000 ms
15-4.000 Ms –
6
92.4,000

5 15.

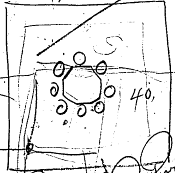
15-4000
12
3 08000
15-4000
22.

2 Eng 25 hp
12–

1 Pres - 2 asst,
gang 4 men + foreman
$2 per day
Smt 13 [illegible] yrs

Portland
3 19.20 Portland
Portland 40000 33.

6 Retorts,
3 [illegible]



Portland
56
Portland
Portland
365
300 Edwin Edwin
1 9 9,5 00 000
Portland
Portland
Portland
Portland

No 49 wire

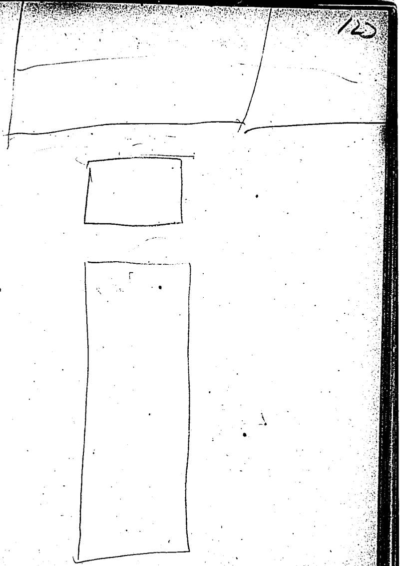
42
4
46) 937.5 (20 3/4
92
175
184

20. ~~turns~~

46) 312.5 (9 layers

20
9
180
2
12) 360
30 feet

170.5 feet



No. 20 mine

39) 937.5 (24

78

157

156

57

39

180

39) 312.5 (8

312

21 times

8

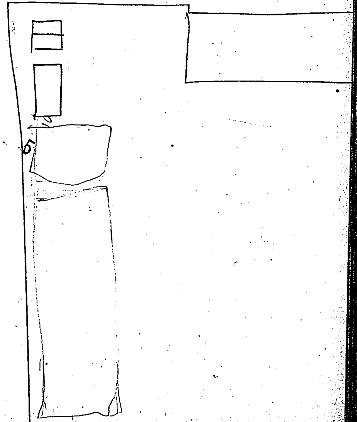
168

2

12) 336

28 feet

118.5



No. 21

.036) 937.5 (26
72
217
216

36) 3125 (8
288
24

26
8
208
2

12) 416
34

Porter Dynamo

To be wound with No 12 B&S = .109 Diameter

.109
11
120
4
480
20
.5

480
w. 480
.20
.20
20
20
3
3
1.046

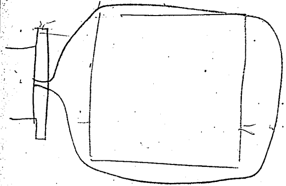
.20.500
1046
19.454

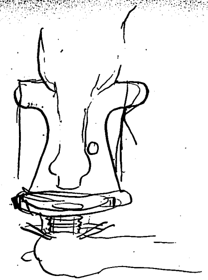
Space	.020	.020
Wire	.480	.480
Binding	.020	.020
Tracing cloth	.003	.003
	.523	.523
	523	
	1046	

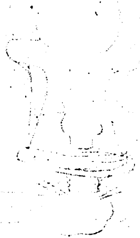
2

500
2

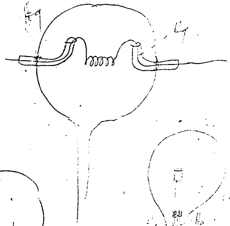
 Large machine
To be wound with one
layer of No 19 BG
=.042 wire

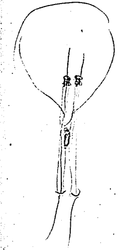


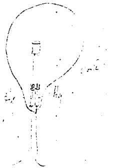




Aug 12 1879







150
125
750

1150

1875 74 9375
148
222
2368
22
4736

1100
.125

137.50

63750 8772
3449
81500
289.375 1221.9

15 521.00

347
3
10.41

137.53
89.33
48.13

1100
19
9900
1100
20900
65

104500
123600
134.0500

7287

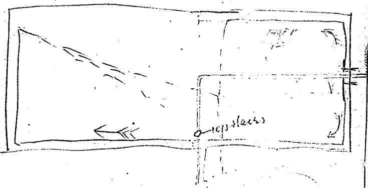
1041 ft 1"
150 ft 3/4

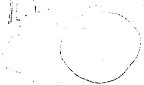
65
27
455
130
1755
65
8775
10530
11.4075

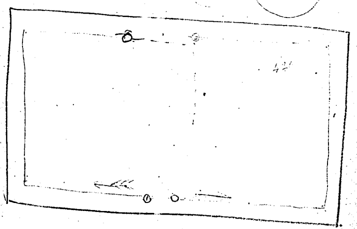
209
134
75

1755
1140
65 | 615
605

1100 ft 1" pipe = $75.00
150' 3/4 " = 6.57
65 . 1/4 " 6.15
87.72 upstairs





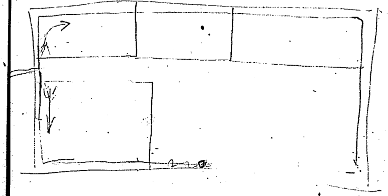


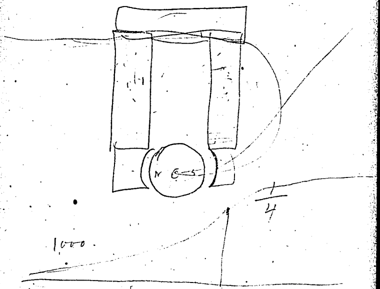
142

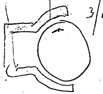
450
7
31.50

450 ft 1" pipe 31.50
75 " 3/4 " 3.27
$34.77

143







5 $1/2$,

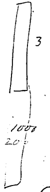
1

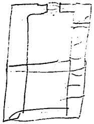
$\frac{1}{4}$

$\frac{1}{8}$

90.

110,





126

$1\frac{1}{2}$

1

2

250

$30 \overline{)100.} - 10 \quad \frac{44}{5.}$ 220.

1000.

30. 10. $33\frac{1}{2}$

10. $\frac{1}{6}$ 10. $3\frac{1}{3}$

8. 144

150

147.

1. $\frac{1}{1.2}$ 98.

127

50.
50.

1 cell, Press 1 Volt,
1. ohm;

44.

$10 - 10.$ $10 \overline{)100.} \; 10 \; 10 \; 44. \; \frac{10}{440}$

10.

440.

158

4

10
10
100.
44
400
400
10) 4400 (440.

~~15~~ 4400 (320.
44

2

110.

300.

220

100h.

200.

110.

$12\frac{1}{2}$) 4400

352

10.

159

1.

1.

.2
1) 44
44
176

8

4
4
16
44
64
64
704

6
6
36
44
144
144
176) 1584 (

3

16 158

132

604
860
5000
344
14400
14400
158,4

70
70
4900
40
19600
196
21560

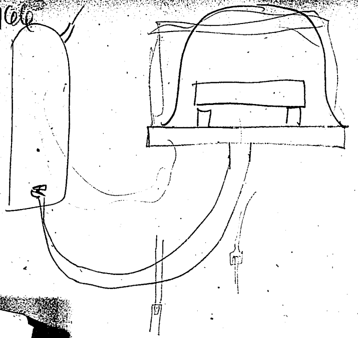
5800
44
25600
25600
281,000

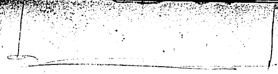
158
3
245

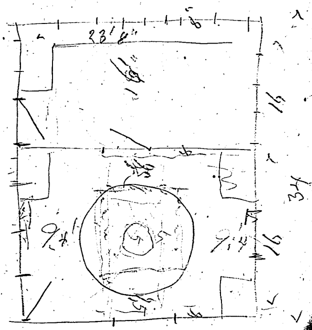
3

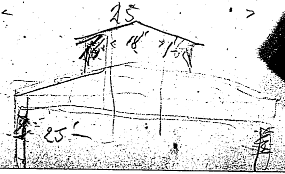
6
6
36
44
144
144
1584

144
4
576
576
2) 6336 (3168



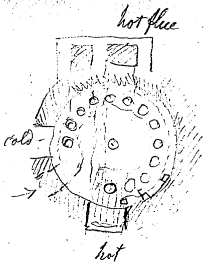


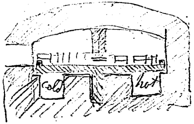

23' 8"
16
34
16

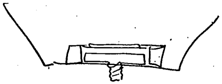

25
18'
25

C

P


hot flue
cold
hot


cold
hot



174.

Shafting cold rolled 175

1	10 ft	3½" Diameter	
1	26 "	3½"	"
1	26 "	3"	"

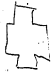
Coupling Collins Pat

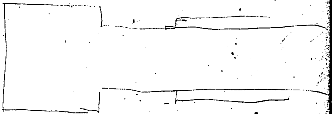
1 3½"

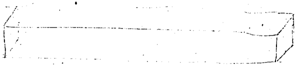
~~1 3~~

Ordered from
Geo Place M. Agency
Jan. 29th 1880.
J K

176 Send for
Porter on Indicator
at Van Nostrand.







Hangers 177

2	3½"	30"	drop
5	3½"	20	"
5	3"	20	"

Ask for distance of bolt holes & size of them also width & length of bases.

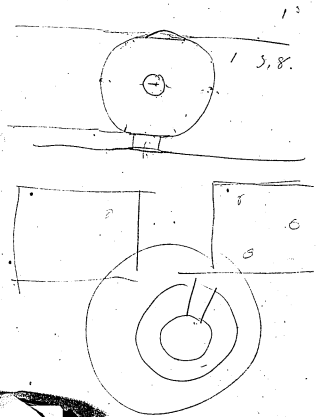
Pulley's

√1	60	Diam	24	belt	3½ 6	High
√1	36	"	24	"	3½ "	"
10	32	"	5	"	3½ "	"
1	36	"	12	"	3½"	"
1	36	"	12	"	3"	"
10	32	"	5	"	3 "	"

1 pair of [illegible]
1 " " 3 "

Have ask for estimate
Jan 28th 1880
[illegible]

178 Have washers & sadle made



Bolts

179

5	1 in	2 ft	9" long	
10	7/8 in	1 "	9"	"
10	7/8 "	1 "	6"	"
20	3/4 "	1 "	8"	"

Ordered Jan 28th
from [illegible] & Bridges
46 Cortlandt Street
N.Y.

Bolts for [illegible] [illegible]
fr. same Jan 31st 1880

Bolts for bearing Brackets

6 1 in bolts 7" long hexagon nuts & head
2 1/2 " " 5 1/2 " " "
6 3/4 screw bolts 6" long " no nuts

6 Windows 10 × 18 glass
wooden building
2 Doors 3 ft × 6' 10"
for Gym B.
Cert.
3 Doors 3 ft × 6' 10"
9. Windows 10 × 18" glass

Bricks for Parlor

42000
42 bbls of Cement
20 yds of Sand

164

Measure
Timber
Watch Digging

Order Lag screws 181
Spikes

55

Diam. = 20" C. = 62.832

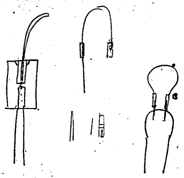
```
.040   4
.040   4
 020
0 20
  02
   2
 22 0
 22 0
    2
    2
-----
 .568
 .20000
   568
-----
 19.432
```

Order Iron Dishes. $19\frac{1}{2}$ Diam with $2\frac{1}{2}$ hole
65 Pieces $19\frac{1}{2}$, $5\frac{3}{4}$ hole
Ordered Jan 31st
Babcock & Wilcox

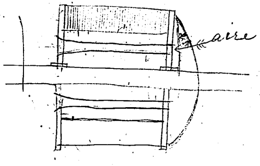
1.0 1/2" [illegible] [illegible] from head to point [illegible] [illegible] [illegible] heads

4 ft 10" X 3 ft 4

7 14

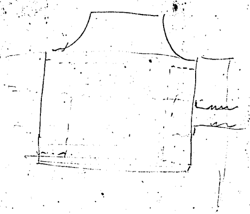


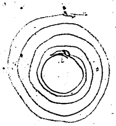
189
1889

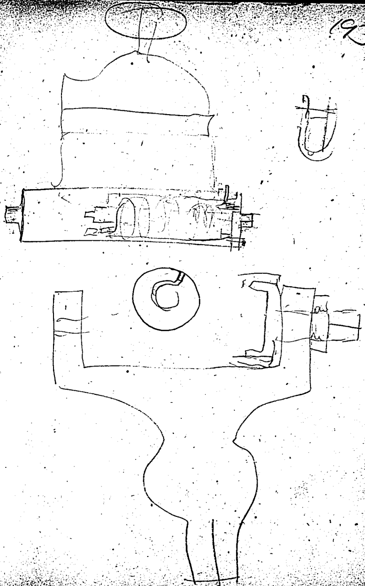


aire hole

14'







197.

overall 18 ft piping in Hg (9)
15 tubes thin, all exposed to air
1 in "
2 of them
fastened at Bottom

191

$\frac{2612}{5}$
13060

3134
3134
13060 V

1738
5
8690

V

2870
2870
8690 V
337,58
5840

Total - 280,18

6 32" × 5" × 3½"
1 36 × 24
1 60 × ~~24~~

1139
16

6774
6260
15164

1 p. 3½ @ 33870
1 " " "
1 " 3 "

7.77
7.77
6.33
1 V
303.25 V

633

589
6
35.34

5656 2137
7542
13198

266.70

2) 3½" 30" hangers
5 3½ 20" "
2 3½ 25 Stands
5 3" 20 hangers

~~62.66~~
~~130.60~~
Total 337.58

6 20" × 5" × 3½ high 53.54
1 20" × 24" × 3½ " 99.34
2 40" × 24" × 3½ " 131.98
1 54 × 24" × 3½ " 129.15
2 pair of 3½" loose collars 15.54
1 " " 3" " " 6.33
358.68

1 piece of shaft 3½ 7 ft long

337.58
358.68
696.26
583.45
112.83

198

6.28 5 3

14 5 3
19.

12

188
54
752
940
10)10152
215
152

250

9

4
18
384
864
6
430

62.80
600
12)3768.00
31.400

628
450
140
4396
12 471..0.
39

Hangers & Pulleys for Extention Building

199

✓1	3½"	30"	Drophangers
✓5	3½"	20"	" "
✓2	3½	25	Stands.
✓5	3"	20	" "

Pulleys.

6	20" X	5" X	3½	high	✓
1	20" X	24" X	3½	"	✓
2	40" X	24 X	3½	"	
1	54" X	24" X	3½	"	✓
1	48 X	9" X	3½	"	✓

Collars

2 pair 3½"
1 " 3"

202

12 6×7×2 1/2 3279 lbs. a 6 1/4 204.94
8 60 36 2306 " " 5 1/4 121.07

7P. 3085 4¢ 15.13 123.40

1639.5 lbs

Brass base 75 lbs.

37 1/2 l. 1 7/8 shaft 9 1/3 per ft.

36 1/2 lbs

6 5/8 6" l
3 1/2 24" "

13
280 269
69 23.12

Materials 203

✓ Brass base		75 lbs		22.50
✓ " bearings		7		2.45
✓ Wr. iron 3	□	273		17.08
" " "	○	546		30.26
✓ " "		25		.40
✓ " "	B&St	33		2.97
✓ bolts 6				.90
✓ "				1.00
✓ Steel		30	4.87	24
✓ End plates				3.60
				4.00
✓ Cast iron		440		17.60
✓ "		65		3.25
✓ Wood		30□'		3.00
✓ Sheet iron				23.12
✓ Copper wire large		70		28.00
✓ " " small		20		10.00
✓ Copper [illegible]				4.00
M. Arm			12	12.00
M. F. C. R.			14	14.00
M. Com.			20	20.00
			7	
Mounting			10	7.00
			2	
B. & B. P.			40.55	10.00
			105.55	
✓ Brass		19		5.10
Sundries ess. etc				4.00
Labor				40.55
				287.02

Material weight
of Cop. wire for one
Core 65 lbs.

Feb 15th 1880

Material for one Far. mach.

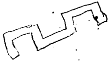
Brass base	75	22.50
" bearings	7 lbs	2.45
" Bolts & Com. rings	19	5.10
Copper for Com.	10	4.00
" wire large	140	52.00
" small	20	10.00
Wrought Iron.		
End plates		4.00
Iron for large bolts & studs		2.97
finished bolts		2.14
sheet iron for washers		.40
" " armature		20.00
Iron f cores		30.26
" yoke		17.08
Steel shaft		3.60
Wood		3.00
Cast iron	440 lbs a 4c	17.60
"	65 " " 5c	3.25
Sundries express freight screws etc.		6.00
V. Fibre		2.10
		208.45
L. total paid		105.55
		314.00

30 lbs

166 3

36 / 6000
240
276
24

12 9



54
156
570

1413
188
11304
11304
1413
2656.44

0

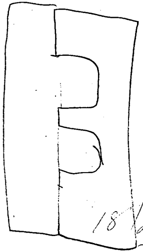
14.5
18
1160
145
261.0

Belting

18 5" 15 ft long
1 12" 21 " "
1 24" 27 " "
1 24" 44 " "

10 5" single 14' 4" long
1 24" double 25 "
1 24 " 44 "
1 12 single 21 "
and 9 ... lacing

6



18 | 261 | 14½
18
81
72
90

Belts ordered from
P. Jewill & Sons March 6th 1880

67 feet of 24" Double belt
and add for 2 laps for
Cement joints
20 ft 12 in single and one lap
33 " 9 " " " "
261 " " " " 18 "

Jed

210

4 3"

7 $3\frac{1}{2}$

Pulleys ordered from 211

Wm Sellers & Co

March 6th 80

4 Pulleys 20" Diameter 5 face $3\frac{1}{2}$ bore

10 " " " " " 3inch "

All high in centre

and for single belt

J.H.L.

212

March 5th 213

Bolts ordered from A. Bridges

100 $\frac{5}{8}$ inch lag screws 8" long
120 $\frac{1}{2}$ " " " $2\frac{1}{2}$ "
2 - $1\frac{1}{8}$ bolts 11" "
4 - $1\frac{1}{8}$ " 19" "
20 - 1" " 7" "
200 5/8 round washers
6 $1\frac{1}{8}$ " "
20 1" " "
6 $1\frac{1}{8}$ washers 4" square
20 1" " " "

J. C.

24

March 18th 1880 21)

Measure of belts

1 24 in — — — 42½ ft without laps

1 " " — — — 25 " "

1 9" single 33 "

18 5" " 15 "

1 12" " 20 "

140
12

24.00

15% 3600.0

6
15
15
15
6.45

20.42
240
4857 81680
4084
12) 4900.80
100
680

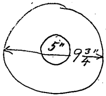
March 19th

Wire ordered from A. Moore
1680 lbs of .134 C. W.
40 Double covered 042 wire
over covering .051

240
720

Mch. 20th Salance & [illegible]

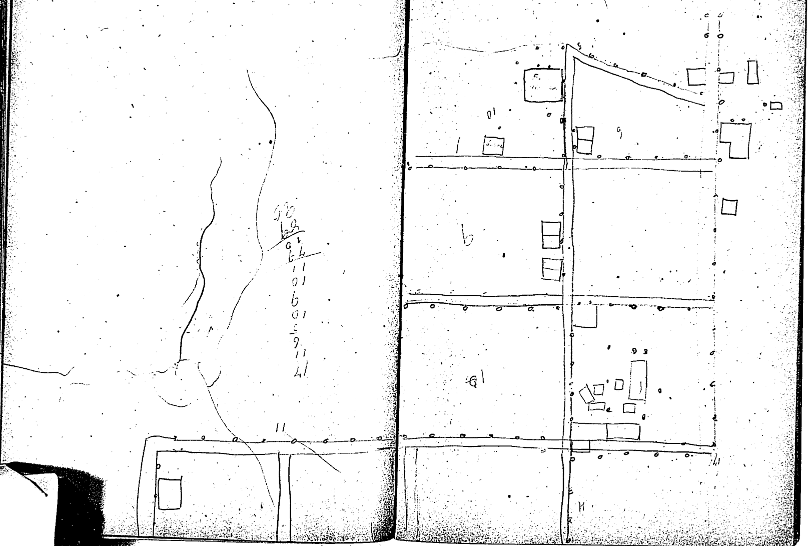
9050 circles .014 Ch. Iron



2250 ~~to be~~ delivered on
as before Mch 29th
The rest Ap. 5th

Babcock & Wilcox

24 $\frac{1}{2}$ Disks $8\frac{3}{4}$" with a
1 5/8 hole   March 20th

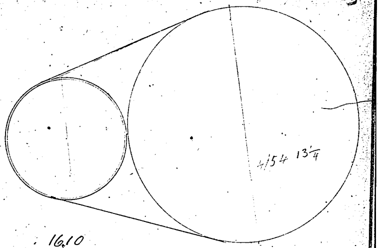


222

March 25th 1880. 223

Ordered for A. J. Buttles
7000 ft large wire strippers &
2000 " small

40.75
314
16300
4075
12225
127.9550 = 128.



16.10

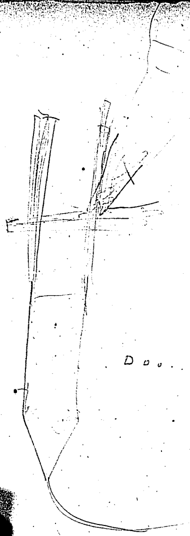
3 3/8
1 12/4
5 1/8

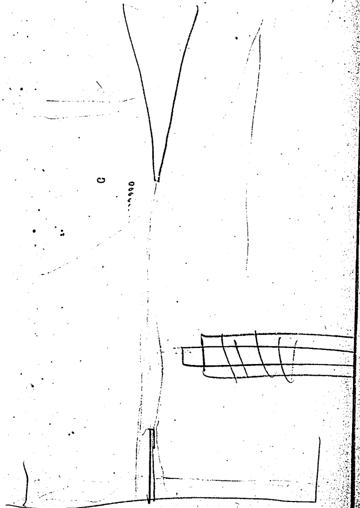
5.497
10.602
16.099 : 2 9/16

8.049

8049
2625
1.0674

14.127 8





~~10.25 = Dia of Bore~~
~~66~~
~~9.65 = " " Fibre~~

10.25 D. B.
6
10.19 D. Fibre
.49
9.70 D. Iron

30
30
60 space
55 20 binding
20 "
220 cop. wire
220 " insulation
3
3 "
5~~4~~6
4
486 5.50
6

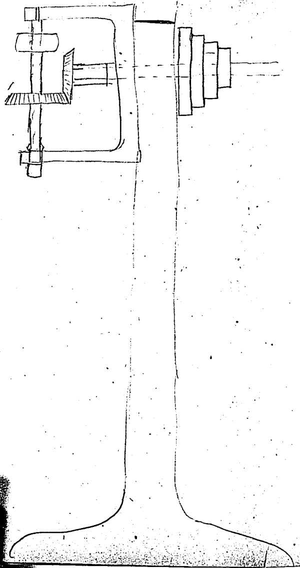
1025
550
5 6875

.625
.11
.625
.625
.6875

10.250
550
9.700

Diameter of Bore 10.25
" " Fibre 10.19
" " Iron core 9.70

Length of wooden core 8.0
Distance between iron flanges 8.68
length of iron tube 8.94



19
12

11
191
11
19
1
191
210

2
585) 1444
1170
304

200
200
40000
23) 40000 (1738
23
170
161
90
69
210

Coppy of Order

1 per 3½ loose Collars

√4 Pulleys 20 D: 5" f 3½ B. H
√10 " 20 · 5 " 3 " "

4 " 10 7½ S.
6 " 10 5½ 1¾ H

---

1 4" Hanger 30 Dy 3½ bore
1 Counter
5 3½ " 26 "
5 3 " 20
√6 20 X 5 Pulleys 3½ bore H
+1 20 X 24 " 3½ " " "
√1 54 X 24 " " " "
√1 48 X 9 " 3½ " "
√2 40 X 24 " " " "

Ordered March 26th

1 one 20 Dia Pulley 12" belt 3½ bore H
1 " 20 " " 12" " 3 inch " H

J.W.

-- Has not come up to March 28th

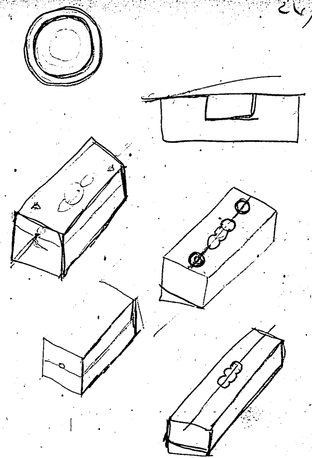
For one Armature
585 rings of .014 iron
and .001 of Tissue paper
between each

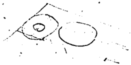
Mch 26th 1880
J.K.

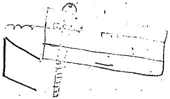
Driving shaft
from Boiler [illegible]

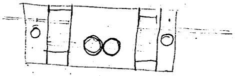
Main sh. to Countr 14 ft 9"
Countre " first line sh: 8' " $1\frac{3}{4}$"
first line to second " 7' —

1 24" belts 41' 9"
1 24 " 24. 7"
1 single 12" " 19. 8"









46. feet per Ohm

4" Diam

18"

.022
.013
.035

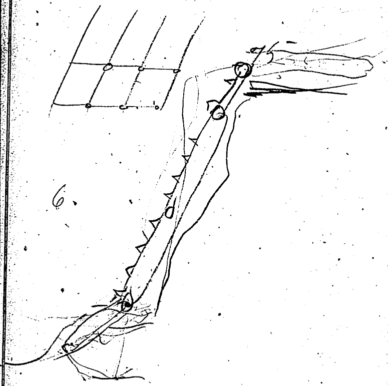
35) 18000 (

4.2552
1.5441
2.7111

510 turns and feet

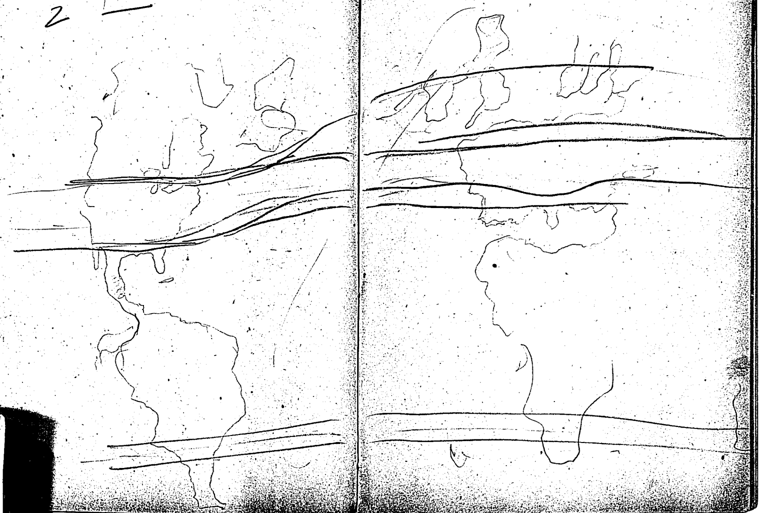
510 2.7111
46 1.6628
1.0483

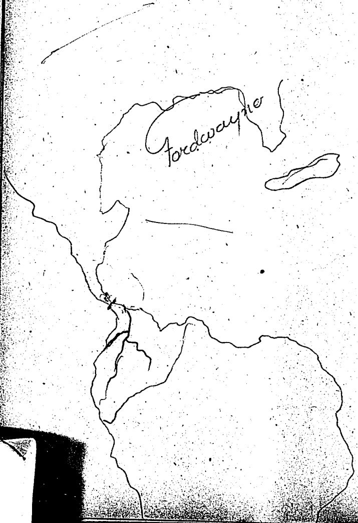
11.2 Ohms per layer
2 sides
22.4 510
3 6
67.2 3060

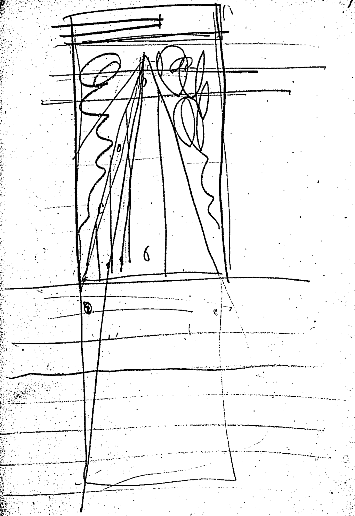


6.

2




Fordwayne



$14\frac{1}{2}$ lb of .035 wire = 5 layers on each break magnet = 20 ohms

5,5 ohms per layer of .022 wire

$$\begin{array}{r} 3.14 \\ .035 \\ \hline 3.49 \\ 3.14 \\ 3.5 \\ \hline 1570 \\ 942 \\ \hline 10.990 \end{array}$$

11

$$.035)\,17.25 - 493 \text{ turns}$$

$$\begin{array}{r} 140 \\ \hline 325 \\ 315 \\ \hline 100 \end{array} \qquad \begin{array}{r} 493 \\ 11 \\ \hline 493 \\ 493 \\ \hline \end{array}$$

$$12)\,5423 = 4.52$$

6 23

4.52 ft per layer

$$46.8)\,4520 \quad 9.6$$

$$\begin{array}{r} 4212 \\ \hline 3080 \\ 2808 \end{array}$$

$$\begin{array}{r} 9.6 \\ 12 \\ \hline 192 \\ 96 \\ \hline 115.2 \end{array}$$

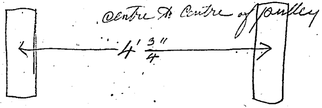
Magnets of Electric Break are wound with 6 layers .022 wire = .53 ohms each.

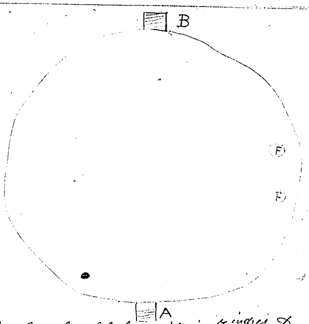
30 ft of 1½ cold rolled shafting
for factory

5, 1½" Hangers 12" drop

1 Coupling 1½

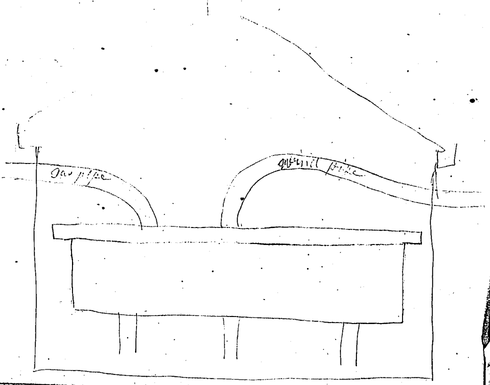
1 Counter shaft measure length.





A Gas pipe
B Wind "
F Fillers

Top of float should be within 2 inches to bottom of wind pipe



264

140

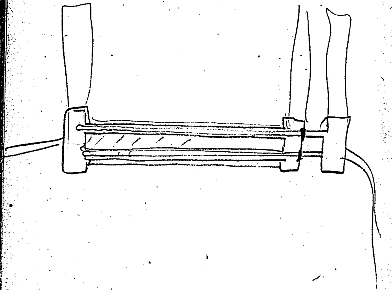
250	28½
12	17
500	156
250	28
3000	436
125	

D to I Contre 3
I " II " 3
III " Pump " 2

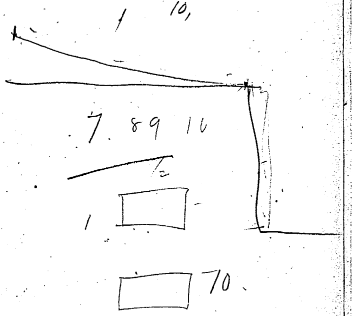
D. 900 10" Pulley
I Ctr 250 36" "
I Contre II^d Pulley 12 "
II " I^st " 30 "
II " II^d " 12 "
Pump 24 "

Rough Estimate of cost of D.C. mg. 1500 265

Poles: 4000 lbs at 4¢	$1.60.00
Dines. castings 1000 "	1.50
Magnets 4800	3.12
Copper wr. 420	160
Thin plates	4.50
Extra on Engine	3.50
Commutator & Brushholders with Labor	200
Copper wire on armature	60
Labor	200
	2042



16, 7



$40 \times 40 = 1600$

$240 \overline{)\,40.0}\ .166$

$40 \overline{)\,7.33}\ .183$

$40 \overline{)\,290}\ 7.2$

$44 \overline{)\,1610}\ 7.33$

$200 \overline{)\,44.0}\ 0.22$

$201 \overline{)\,1.000}\ 0.00497$

$220 \overline{)\,20.00}\ .091$

$41 \overline{)\,300}\ 7.31$

$241 \overline{)\,40.0}\ .166$

20 ohm
40 Volts on 200 ohms

$C = \frac{E}{R} = \frac{E}{r+R} = \frac{40}{40+200} = \frac{40}{240} = .166$

$V^2 \times 44 \div R = Ht = 40 \times 44 \div 240 = 290$

$=$ ~~.183~~ per Volt. 7.25

1 cell $= .22$ per Volt

1 Volts

$\frac{1}{201} = .00497$

$1^2 + 44 \div 201 =$

$.22$ Hts per Volt

10
20
40
41

$= 7.25$ per
7.31 per Volt

20 Volts

$\frac{20}{220} = .091$

$20 \times 20 \times 44 \div 220 = 80$

$\frac{1}{4}$ per day
80 " "
290 " day
299.7

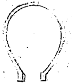
$\frac{41}{41+200} = 241$

73.1 per Volt

7.31
41
299.71

284

330.064
78.54
1524



Menlo Park Notebook #57 [N-80-03-06]

This notebook covers the period March-October 1880. Most of the entries are by Charles Batchelor and Charles Flammer. There are also a few entries by Edison. The name of Martin Force appears occasionally as a witness. Many of the notes and drawings relate to experiments in treating carbonized paper and fiber. Most of these are numbered. There are also notes and drawings of clamps, internal connections, carbon molds, and devices to straighten the carbons. One set of notes and drawings relates to a series of vacuum pump experiments. The label on the front cover is marked "Carbons" and "C. Batchelor." The book contains 284 numbered pages.

Blank pages not filmed: 270-277, 282-283.

Missing page numbers: 75-76.

Lamps

Try immediately — Mch 6th 1880 — 1

Soak .015 paper in following Solutions

X | Thin Solution, Tar, in ~~Benzine~~ Kerosene, 2

X | " Ordinary

" Gum Dextrine

Make some very th
pull it out in st
carbonize.

Try immediately — Mch 6th 1880 — 1

Soak .015 paper in following Solutions

X Thin Solution, Tar, in ~~[illegible]~~ Kerosene,

Tar Rubbed on hot

X Soaked in [illegible] Oil,

X Soaked in [illegible]

X " Venice Turpentine

X " [illegible] Turpentine

" [illegible]

X Make some very thick [illegible] pull it out in sticks and carbonize.

2

Try immediately Mch 7th 1880 3

Soak paper in following. Chas Batchelor
M. N. Force

X Tragacanth.

X Soak in Anthracine in its best solvent.

X Soak in, Napthaline in its best solvent,

~~Fusel oil.~~ dont try —

Take a piece of Tin foil
cut it out size small loop
paint it ~~with~~ syrup of
plumbago & sugar;
lay on ~~[illegible]~~ on iron
plate & bring up to melt
foil, then put in lamp

Lamps March 8th 1880 5

Chas Batchelor
M. N. Force

841	Carb. 134. Book 70 Manilla fibres -.004 thick - picked - copperplated
842	Carb 129 Book 70 Palmetto leaf fibre — coppered —
843 844	Palmetto leaf - coppered
c. 135 845	Carb. 145 Two threads
846 ~~847~~	Wire grass from Florida Coppered Bad place at top —

Try immediately:- Oct 8 1880

Chas Batchelor
M. N. Force

Take	ordinary small loops of .015 pressed to .007 and after carbonizing - place them in Hydrofluoric acid to dissolve out the glassy matter that has been formed there by the intense heat
Take	some very fine Sea Island cotton fibres (single) and make loops
Take	some very fine Bass fibres and coat with plumbago and Sugar
Soak	some in Gelatin
Soak	some in Cyanide of NH_4
Soak	some in Cyanide of K

Lamps

848 849	Palmetto leaf fibre - copp.
850 851 852 853	Small loop soaked in starch and H_2O and Pressed carb 154
854 855 856	Palmetto Leaf Copper
857 858 859 860 861 ~~862~~ 863 864 865 866 ~~867~~ 868 869 870	Small loop of 015 soaked in Sulphate Ammonia and pressed 871 872 873 Carb 150 874 875 876 877 878 879 880 881

Carbonization Mch 8 1880

Chas Batchelor
M. N. Force

141	Plumbago and Venice Turps, rolled to stick and bent in Shape
142 143	Small loops -·015 Soaked in Turpentine and pressed
144	Piece Rosin with plumbago, made hot when cool it dries hard - very hard but a little too fluffy
145	Plumbago ~~[illegible]~~ Tar hand rolled. bent in shape,
146	Ditto - as 145 -
147	Small loop ·015 Soaked in Aniline oil and pressed

Chas Batchelor
M. M. Force

148	Venice turpentine and Plumbago.
149	Same as 147
150	Small 3 moulds loops of '015 soaked in Sulphate Ammonia and pressed
151	Small loops '015 — soaked in Resin in alcohol. — pressed —
152	Small loops '015 soaked in Naphtaline dissolved in Bi Sulph Carb, & pressed

14

Carbonization Mch 9 1880 (2)

Chas Batchelor
M. N. Force

153	Small loops .015 soaked in Tar dissolved in Kerosene and pressed
154	Small loops soaked in Starch and H_2O & pressed
+155	Small loops (Tragacanth) soaked in
156	Large loop Soaked in Sal Ammonia
157	Mixture of Plumbago and " made by McKenzie 3 in long — lying in tissue paper —

Lamps   Mch 13th 1880 / Chas Batchelor

149 882 883 884	Small loop ·015 soaked in ~~oil~~ Aniline oil and Pressed carb 149
885	Carb 155 Small loop soaked in [illegible]
886 887	Small loops – ·015 unpressed – pressed to ·007 – treated with Hydrofluoric acid and plated with Copper
888 889	Carb 153 Small loops – ·015 unpressed – ~~pressed~~ Soaked in Tar dissolved in Kerosene coppered

890 Carb 152 Small loops ·015
891 Naphthaline dissolved in Bi Sulp
892 Carbon and pressed to ·007
Coppered

~~893~~ Carb 150.
894 Small loops — ·015 uncal. paper
895 Soaked in Sulphate Ammonia
~~896~~ pressed to ·007 — coppered
~~897~~
~~898~~
~~899~~ did not use these lamps
~~900~~ Broke them up to get lamps
~~901~~
~~902~~

903 carb 177 Small loop 015 soaked
904 in Aniline oil and pressed
905 Cop.

906 Carb 160
small loop 015 uncal paper
Soaked in Resin dissolved in
alcohol and pressed — Cop —

Chas Batchelor
M. N. Force

158	Plumbago and Made by McKenzie — laid on carbonized tissue sheets in mould
159	Plumbago and Made by McKenzie without tissue.
160	Small loops — .015 mical paper Soaked in Resin dissolved in Alcohol and pressed to .007
161	Bass fibres coated with Plumbago and Sugar

Carbonization Mch 14th 1880 2
Chas Batchelor

162	Manilla fibres picked
163	Small loops '015 impressed soaked in Anthracine in Turps. and pressed '007
164	Cocoa nut fibres picked
165	Black Moss - from Florida with joints in it -
166	Ramie fibres - a number together - It is almost impossible to split them to get a single fibre of any length.

Carbonization Mch 14 1880

Chas Batchelor

167	Bass fibres small all Broke
168	Small loop soaked in Resin and Alcohol Ress to high
169	Bass fibers Small [illegible] high
170	wire grass 3 loops
171	2 moulds 3 Small loop and 3 large loop Acetic Acid Pressed from 0'15 to 0'07 3 large loops to high Res

26

Try immediately
small loops in =! Mch 14 1880
Chas Batchelor

Acetic Acid $C_4 H_4 O_4$

Acetone $C_6 H_6 O_2$

Mastic $C_{40} H_{31} O_2$ in Benzine or turpentine

28

Lamps

March 1884

907 908	Small loop ·015 unpressed soaked in Anthracine in Turpintine and pressed ·007 carb 163 Coppered
909. 910.	first pressed plumbago small loop from new mould made ~~f~~ by Dean tissue paper on both sides of loop — Coppered
911 912 913	Picked fibers Manillie small carb 162 Coppered
914	Carb 160 small loop ·015 uncal paper soaked in resin Disolved in alcohol and pressed ~~to~~ ·007 Coppered

Carbonization March — 1880

172	fibres from the young Palmeto leaf
173	3 Small loops and 3 large loops Gelatine Solution Pressed 010 to 007 large loop to high Res
174	Small loop Molasses Solution 015 Pressed to [illegible]
175	Wire Grass large loop

32

Lamps

March 16 ~~3~~

915	1 ~~full~~ round fiber wire grass Coppered Carb 127 "
916	Bass fiber coated with Plumbago and Sugar carb 161 Coppered
917 918 919 920	Manilla fibers picked Carb 162 Coppered
921 922 923 924 925	Manilla fibres - Carb 162 - Coppered

March 17 1880 —

Lamps

926 927 928	Cocoa Nut fibers [illegible] copered ends Carb 164
929 930	small loop soaked in Acitic Acid Pressed 015 — 007 carb 171
931	wire grass coper ends carb 170
oper 932 ichel 933 ilver 934	small loop Gelitine salution Pressed 015 — 007 carb 173 nickel coper and silver Plated ends

36

Lamps

March 18th 37

935 942
936 943
937 944
938 945
939 946
940 947
941 948
949

Small loop Carb 174
Molasses Solution
No Pressed to 007.

950
951
952 Broke

wire grass Plumbago ends
carb 175.

Coper 953
C" 954
C" 955
Plumbago 956

fibre from the young
Palmetto Leaf Carb 172

957
958

Carb 165
Black Moss from
florida with points in
it copper Plat ends

Carbonization Mch 18th 1880

Chas Batchelor

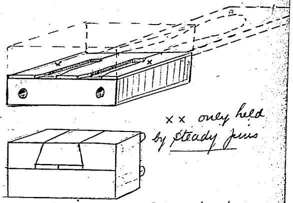
176	Plumbago pressed between tissue sheets cut out and soaked in Molasses.
177	Manilla fibers 2 Bunches picked Broke in mould
178	Small loops soaked in cyanide K. – pressed to very
179	Manilla fibres – with moulded plumbago ends

Lamps

959	Cocoa Nut fiber
copper 960 961 962	cop Picked Carb 164
963 964	Plumbago on ends
965	fiber from the young Palmetto leaf carb 172 silver Plat ends
966 967 968	Carb 169 Bass fibers small coper Plat ends.
~~969~~	~~Carb 159~~ ~~Plumbago on~~ — ~~made by McGowan~~ ~~[illegible]~~

Mch 18th 1880

New Mould for moulding plumbago ends on Fibres after Carbonizing



xx only held by steady pins

Piece on back of this to keep punches from pushing back all surface hardened and polished
Chas Batchelor

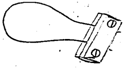
Made by C Dean

44

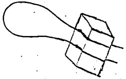
Mch 18 1880

Devices for keeping the ends of fibres straight whilst Carbonizing —

Platina sleeves



Nickel clamp.



Nickel - sawed slots in it

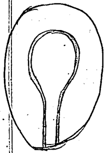
Nickel block with forming block on it round which the fibre is stretched a bit and put loosely through holes at x x as it shrinks it pulls through and always keeps good shape

Chas Batchelor

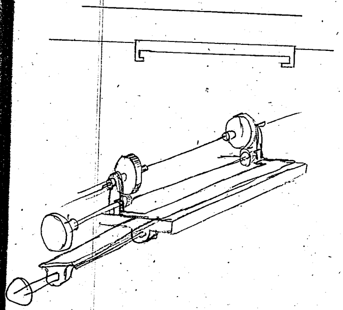
46

Mch 19 1880

Devices for Keeping ends of fibres straight whilst carbonizing



Nickel plate with groove in shape of loop polished out so as to slip



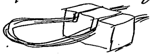
Chas Batchelor

180 Manilla fibres - soaked and bent to shape

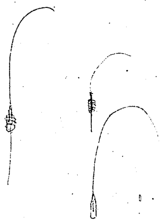
181 Plumbago T
Made by McKenzie —

182 Piece of reed paper (I think) sent by from Wales Penn.:
looks like Gold beaters skin

183 One Manilla fibre held by piece of nickel in place

184	lot of Manilla fibres together in groove 
185 186	Bunch Manilla fibres
187	large loops cut from Whiting paper Company's sample No 3
188	2 manila fibres in new Bass clamps by Batchelor Chas C, F

See page 63



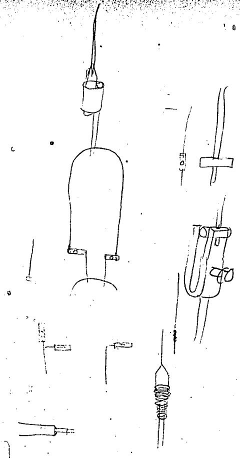
Lamps.

969 Manilla fibers Carb 180
970. Plumbago on ends of carbons
971
972

973 Manilla fibre – clamp of
Plumbago moulded ~~on~~ with hole
in and fibre stuck in hole and
clamped with plat-Irid. clamp
this did not clamp good it
stood this way
So was not a fair ~~test~~

974 Carb 187
975 Large loop cut from
976 Whitney Paper Co
977 clamped with pure Plumbago
978 on ends of carbon put on
979 dry [illegible]

56

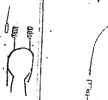


March 23rd 1880

Chas Batchelor

57

Make



Clamps of Bast fibre :— .015 thick and .075 long before carbonizing — Pointed and a .0065 hole through so that the fibres will just push in — Then Carbonize —

To hold this we will make a spiral ( ) of platinum wire, that is two sizes, made on a mandrel so:—

the small end to go on the .0010 wire (or .007 if we use it) and the large end to ~~set the cup~~ clamp in.

In order to make these clamps we will pick out the fibres about the right size and draw them through a given

Chas Batchelor

die which cuts them to .025 thick these are then put in our little screw machine milled down-drilled - and pointed

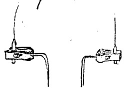
Cut some of them double length to try experiments

We are also taking pieces fibre (Bast) and cutting them off and drilling as:- crosswise and clamping the crosspiece in our ordinary clamp.

Mch 23 1880

Chas Batchelor

We will clamp this clamp also this way



Also this way

188 Page 53 —
These clamps are Bast fibres
the Manilla fibres are 5
thousandths and 3 inch long

189. 6 manilla fibres with
Bast clamps ·015 thick

fibres 2" long
" ·005 thick

190 Manilla Fibres ·007 —
~~3 in~~ length 2·5 inches
Bast clamps
·0625 long
·025 thick

191 Vegetable Wool.

Lamps March 26 1880

Chas Batchelor

980	Manilla fibre ·005 thick 3·5 inch long Bast clamps set in spring cups and pure plumbago set in — Measures 2800 ohms before going on pumps Busted Arc in one clamp

C.C.

Lamps

March 26 1881

980 Carb 181
981 Large loop cut from
982 blotting paper 50-
983 samples of [illegible] Rindsop
[illegible] of Carbons, [illegible]
in [illegible] pure alcohol

984 Manilla fibre
2" long } Bad clamp
·005 thick } small size

985. Manilla fibre
986 2½ inch long

C.P.

Carbonization Mch 26 1880
Chas Batchelor

192	Ramie fibres
193	Manilla fibres '006 thick length 2' inch
194	3 ordinary 187s. but with lots of loose paper at bottom 200 224 220
195	3 ordinary 187s paper in bottom and 2 sheets tissue between each loop
196	3 ordinary 187s paper in bottom and nickel plates on top with 3 sheets tissue between each

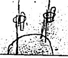
196	6 tissue sheets bottom ~~at~~ bottom 6 " on top 3 between each loop (None) nickel plate on top
197	4 tissue sheets bottom on nickel plate 3 sheets between every loop 4 sheets top carbon on top 190 192 198
198	Paper at bottom carbon plate top and bottom high resistance
199	3 sheets tissue between each loop ~~tissue at bottom~~

200-206 @ 2621

Lamps

March 29 1880

987 988 989	Manilla fibre
990 991	Manilla fibre oak clamps carb 204
992 993	Manilla fibre Holly clamps carb 206
994	manilla fibre oak clamps see top page 61
995	manilla fibre oak clamps with ~~nam~~ wedge clamp



Carbonization

200 Lot of tissue on bottom
nickel plate
3 tissue sheets top and bottom
2 sheets between each loop
tissue on top —

101 [illegible]

In carbonizing we find that 3 sheets between each loop makes less R.

202 Put up 3 at bottom } loose paper at bottom
3 between
3 top
4 [illegible] old [illegible]
2 new nickel plates
nickel plate on top

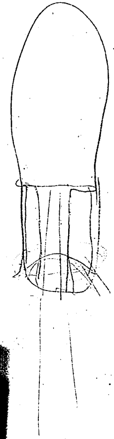
We also find that nickel on top is not a bad thing as the only mould we tried it on is very low 192 ohms but this may be due to the 3 sheets between each loop

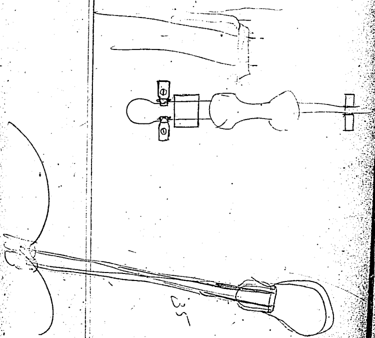
Carb. | March 30 1880

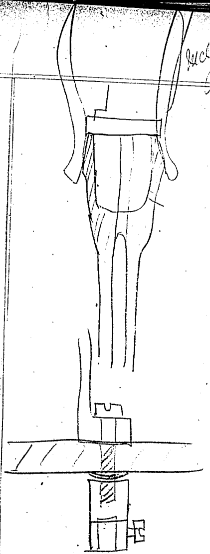
208 Lot tissue at Bottom
nickel plat
2 [illegible]
1 Bet [illegible] loop
2 on
carbon [illegible] on top
lot [illegible]

204 2 moulds .007 Manillas
$2\frac{1}{2}$ long in oak clamps.

Today on taking out the moulds 15 moulds. which shows us that
3 sheets between each and nickel plate on top are the best yet

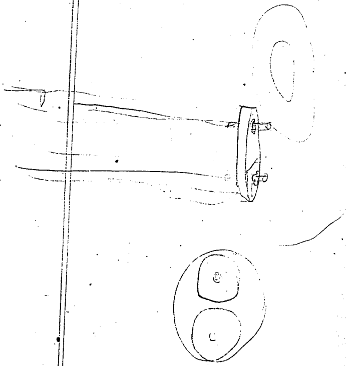






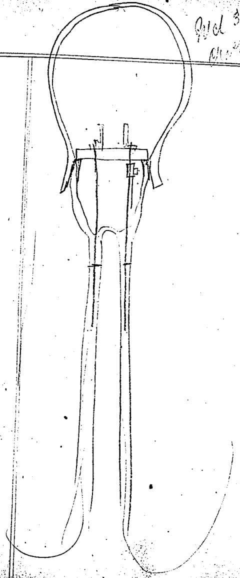
Dec 30 1880

Chas Baldwin



86

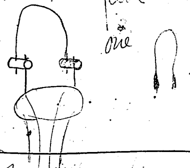
Jul 30 1880
Chas Batchelor



March 8
30th/1880

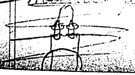
206 Manilla fibre with clamps made of [illegible] for particulars see Lamps 9 84

207 Manilla fibre and one



205 Manilla fibre and [illegible] [illegible] dou[illegible]

~~206~~ ~~Manilla fibre~~



Ho...

996 Manilla fibre
oak clamps

Plat clamp Carb 204

997 Manilla fibre — holly clamps —
new shaped glass — clamps set
on regular clamps

998 manila fibre with
oak clamps carb 212
999 in reg clamps

1000 Manila fibre
1001 Oak clamps put in
1002 reg — Plat clamps put in
long bulb Carb 210

1003 Manila fibre
1004 in Box wood clamps
and reg Plat — clamps
Carb 213

Chas Batchelor

208 3 Manilla fibres —
— Boxe wood ends N.G.
Put in tissue paper
with holes cut in
so that clamps
can have room

209x Same but ~~with~~ no holes
in tissue paper

210 6 Manillas — boxwood
clamps — carbonized in
slots of nickel plate

211 Double Manilla fibre
in oak clamp

94

Carbonization Apr 3rd 1880

M. N. Force

212 Manilla fibres — oak clamps —

213 9 Manillas — boxwood clamps — Carbonized in slots of nickel plate slots filled in with paste board to hold them in place

214 One double manilla fibre in boxwood clamps

215 2 Double manilla fibres (Double clamps came out bad) & four single manillas all oak clamps Came out good

had carbon weights on them

216 One Manilla fibre between two nickel plates boxwood clamps

96

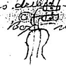
Carbonization Apr 5th 1880 97

217	Large bunch fibre Manilla: laid on 5 Tissue then packed allround + inside with Cuttings then Cuttings over then tissue + heavy nickel plate — Pressed hard — Lid don't shut down
218	3 Big paper Carbons · 15 tissues between each. over last put Cuttings. Then nickel plate — Lid shut down — R 226 — 222 — came out very good
219	66 Manillas fibres put in with a sheet of tissue between each fibre then a heavy nickel plate to weight them down. Then packed in with cuttings.

Lamps

April 8 1880

Chas Flammer

1005	2 manilla fibres in old style clamps with 2 holes drilled in them to clamp on Box wood clamps 
1006	Manilla fibre
1007	Box wood on ends of fibre
1008	old style clamps
1009	1 loop made of gum wood put in old style clamps Carb 233
1010 1011	2 loops made of White Holley put in old Stile clamps. Carb 228

Carb April 8/1891

220 5 single and
2 Double fibers in
slots of nickel plate

Box wood

221 ~~4~~ [illegible]
[illegible] ends are
held in slots [illegible] plate

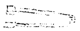
222 5 loops cut from Box
wood and bent in shape
so  ends held in
slots of nickel plate
and weighted with carbon
plate then nickel plate
on top with plenty of [illegible]
paper

223 6 ~~sloops~~ cut from
willow Carb same as 222

102

Carb April 88

224	5 single fibers [illegible] 2 Double " [illegible] Oak clamps weighted with carbon
225	3 [illegible] cut [illegible] Bass wood and shaped so [illegible] held in slots cut in [illegible] wood ~~with~~ ~~Slots~~ of albuse Tissue paper
226	8 [illegible] cut from the willow wood and bent with steam so [illegible] held in slot [illegible] nickel plate
227	Manilla fibre with oak clamps cut in slots of nickel plate weighted with carbon

228 2 loops made from White [illegible] wood ~~and~~ bent with steam in shape to  6 times. [illegible] on top and [illegible]

229 2 loops made of Bass wood bent same as 228 but where not ~~[illegible]~~ steamed enough broke in bending. then bent flat.

230 4 loops made of ash wood bent same as 228 bent very good

Carb

April 10 1880

231	2 loops made of White Holly bent edge ways with steam.
232	4 loops made of French Poplar and bent edge ways. and carb same as paper loops 2 in a mould
233	2 loops made of Gum wood and [illegible] same as 232
234	White pine page 111 Lamps 1014 & 1015.
235	Dog wood page 111 Lamps 1014 & 1015

236 Peach wood see page 111
Lamp 1014 x 1015

237 Gum wood
see page 111
Lamps 1014 x 1015

238 Maple wood
see page 111
Lamps 1014 x 1015

239 Ash wood see page 111
Lamps 1014 x 1015

Lamps April 13 1880

1012
1013

2 loops made from Box wood steamed and bent the shape as put in old style clamps these where milled same as a tuber

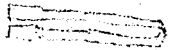
Carb 222

April 15
1014
1015

2 loops made of Gum wood cut by Dean so where steamed and bent in shape so Then carb with 3 sheets of tissue paper between each loop and heavy nickel plate on top carb very good

Carb 237

Cark April 13/13

240	Red cedar see page 111 Lamps 1014 x 1015
241	Beach wood see page 111 Lamps 1014 - 1015
242	are one ash and one Bass Steamed and Bent so 
243	French poplin page 111 Lamp 1014 x 1015
244	Black Walnut page 111 Lamps 1014 x 1015

Carb April 14/10

245 Amaranth wood see page 111

Comp 1014 x 1115

April 15

246 ~~6~~ 6 ~~Solid~~ loops made from White Holley put in 5 moulds in diferent ways

Boardin mould

1

3 tissues on botom
3 between each loop
3 on top
1 heavy plate on top

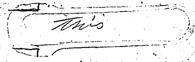
2

Not bad

3 tissues on botom
2 between each loop
3 on top
2 light plates on top

6 on Botom
6 between every loop
6 on Top
1 heavy plate
Not Good

These loops where cut new way



They are not reglar cut thin places on them

Lamps April 15/17

1016	Red Cedar
1017	Carb same as 1014 x 1115
	page 111 2 good loops
1018	Peach wood Peach wood
	Carb same as 1014 x 1015
	page 111 1 good loop Carb 236
1019	Amaranth wood
1020.	Carb same as 1014 - 1015
	page 111 Carb 245
1021.	Maple wood
1022	Carb same as 1014 x 1015
	page 111 carb 238
1023	Black Walnut
	Carb same as 1014 x 1015
	page 111 . Carb 24

Lamps April 1st 17

1016 1017	Red Cedar Carb same as 1014 x 1015 page 111 2 good loops
1018	~~Peach~~ wood Peach wood Carb same as 1014 x 1015 page 111 1 good loop - Carb 236
1019 1020	Amaranth wood Carb same as 1014 - 1015 page 111 Carb 245
1021 1022	Maple wood Carb same as 1014 x 1015 page 111 carb 238
1023	Black Walnut Carb same as 1014 x 1015 page 111 carb 24

1024
1025 White Holley old style clamp
Carb — 246

1026 Paper loops cut with new
1027 horseshoe mould cut by Vancliff
1028 for steam ship
1029
1030
1031
1032
1033
1034
1035
1036
1037

1038	1046	1055	1063
1039	1047	1056	
1040	1048	1057	
1041	1049	1058	
1042	1050	1059	
1043	1051	1060	
1044	1052	1061	
1045	1053	1062	
	1054		

Lamps

April 29 1880

C.F.

1064 1065	White Holly wood Plained on shaper very thin and cut in new Horshoe mould R. 194 x 125
May 5th 1066 1067 1068 1069	Paper Carbons cut with new mould with new Platinum clamps carbons have holes Drilled in ends of them so that screw would go through them
Broke at clamp 1070 1071	coper clamps made same as reglar platinum clamps with carbons from new mould 1071 carbon broke at clamp K.G.
1072 1073	coper clamps made very short so that would have to drill holes in carbons for screw to go through carbon in them from new mould K.G.

N.G.

No good

N.G.

No good

Lamps

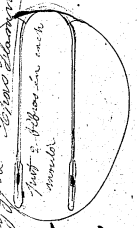
May 5th 1880 123

1074	nickel clamp made short so that would have ~~to~~ drill Holes in carbon for screw to go through
1075 1076	Platinum clamp very short so would have to drill holes in carbon carbon cut in old mould
1077	Coper clamp ~~see~~ 1075 and 1076 No good N.G.
1078	Coper clamp made same as Reglar platinum clamps with carbon cut from old mould No good N.G.

124

May 18 1880

mould for Bass fibres
5 inches long to lay fibres in Slot
and ends will ~~draw~~ draw up in carbonizing
very good Chas Flammer



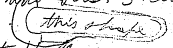
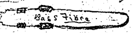
No good

No good

Lamp

May 12th 1880 23

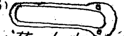
Chas Flammer

1079 1080 1081 Plumbago on end of 1081	wood carbon loop made by Chas Dean on cam machine this was first 3. cut  White Holley wood
May 18 1082 ✓ 1083 ✓ 1084 ✓ 1085 ✓ 1086 ✓ 1087 ✓ 1088 ✓ 1089 ✓ 1090 Broke 1091 Broke 1092 broke 1093 1094 1095 1096 1097 1104 1099 1105 1101 1106 1102 6 1103	Bass Fibres carb in Stops of nickel plate 5 inches long by 14 thousands thick cocoanut shell clamps on ends of fibres  May 18-19-20 see page 124
	29 Bass fibres lamps were made

126

Gen'l

May 22 1887
Chas Flammer

1107 Box-wood K 103 carbons made from
1108 ~~Apple-wood~~ K 243, 
1109 Mapple-wood-K 165, with short clamps
1110 Satin-wood-K 133, did not carb- very good
1111 White Holly-K 230
1112 White wood K 175 Carb very good in slots of nickel

May 24

~~[illegible]~~ where put in nickel plate ~~same~~ as Bass Fibre ~~[illegible]~~ as on page 125 or 124

May 29

1113 Box wood
1114
1115
1116

These where strait carbons

Could not get these in short clamps were not flat on ends very easy to Braake

1117 White Holley
1118
1119

These where strait carbons

These same as above

March 31-1880

Chas Flammer

Lamps

1120 Box wood

1121

1122 same on page 127 Lamps

1123 1128 White Holly

1124 1129

1125 1130 These where not reglar

1126 1131

1127 1132

1133

1134

1135 Bass fibres 12/1000 square & 5/8 long

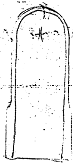
1136 cut shape so

Carb - in shape so

old still clamp

1137 1138 one end drawed up more than the other Edison says put them had to spring ends straight

Measured the Res of one was 330 Ohms



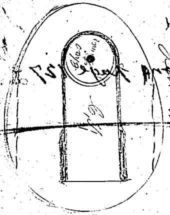
Chas Flammer

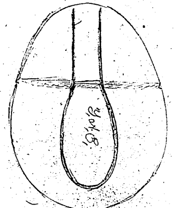
Carb— June 17

1120 Bass wood

same as page 127

Chas Flammer



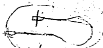
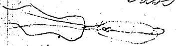
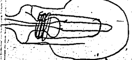


June 8

Lamps

June 17 1880

Chas Flammer

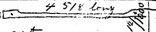
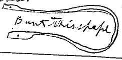
June 14th 1139	Bass Fibre < 4 5/8 long >
June 15 (1140, 1141)	bent in shape and carb— so
1142	 one end is
1143	held by a pin made from Platinum
1144	wire so that there would be a
1145	end to draw carried with the other
1146	has a piece of flat glass between carbon same as this. Bass fibre same as above
	
1147	has a piece of isinglass between carbon.
	

132

Lamps

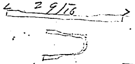
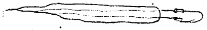
June 17 1880 (3)

Chas Flammer

1148/1128 1149/1129 1150/1130 1151 1152	Boss Fibres with pith taken out  
1153	Bass Fibre lamp has a pertison made of ising gum gauged be for Carb O.K. by Jim Bradley
1154	Bass fibre cut in two and Carb Edison wanted to try 2 halves Broke one
1155	same as 1153 ~~soften~~ all ~~through~~ and small in center ~~through~~ gauged by Jim Bradly
1156 1157	Bass fibres tapering from 12/1000 to 9/1000 — 4 5/8 long
1158	Bass fibre No 2 small on one end and center but solid do
1159	Bass marked O.K. means all solid by Bradley

134

Lamps June 17th 1880 35

1160	Bass fibre  2 9/16 put in new clamp has the smalest screw the we can make weight of clamp .174
1161 1161.A.	same as 1160 only in side part was made strait 
1162 1163 1164	Bass Fibres reg-lar
11.65	No 5 O.K. Bass Fibres
1166 June 22	Bass Fibre No 4 smaller one end only but solid

 June 22th 1880

Bass fibres Carb by Van Cliff — Chas Batchelor

June 22th 1880 long 𝍸𝍸 1 one was very bad
" 11
short 𝍸 1

June 23 — 1880 𝍸 11B large
11B small

Broke one

June 25 1880 𝍸 1111 large
𝍸 small

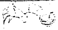
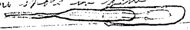
June 26 𝍸 1111 large
9 1 small

June 28 1880

large loop 111 1111 𝍸 𝍸 1111

Lamps — June 22 —

Chas [illegible]

1167 1168 1169	Bass Fibres regular
long clamp 1170 long clamp short clamp 1171 " " 1172 short clamp	Bass fibres 2x1/16 long 7/1000 thick short clamp and long clamp 
1173 1174 1175 1176	Bass fibres regular 
June 23 light color 1177 1178 1179	Bass Fibres there are [illegible] difference in color of fibre 2x1/16 long by 12/1000 thick all solid had no spots in them 
1180 1181	Bass Fibres Regular
Dark Color 1182 1183 ~~1184~~	Bass Fibres No 4 3 dark see Lamp 1177

Listed by Boehm

136

Lamps . June 23 1880

Chas Flammer

cab

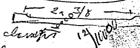
1185 Bass Fibres reglar x
1186 cab

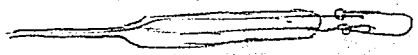
1187 Bass Fibres 4 x 5/8 long 12/1000 thick
covered with plumbago.

1188
1189
1190
1191
Bass Fibres
Reglar

June 25
1192 2 Reglar Bass Fibre
1193 put in smallest clamp
made 4 x 5/8 long
12/1000 thick

1194 Bass Fibres
1195 put in small clamps
1196 and strait glasses
1197





Bright

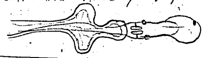
Lamps

June 25th/1881

[illegible]
Chas Flammer

June 25

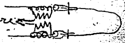
1198 Bass Fibres
has 2 Disks of platinum
same as this 1/16 apart



June 25

1199 Bass Fibers 4. 5/8 long
1/2 | 1150

June 26th Platinum wire



1200 Bas Fibres Regular
1201
1202
1203 these where put in large lamps
1204
1205
1206
1207
1208 put in small lamp
1209

Lamps — June 28 1880 — 3

Chas Flammer

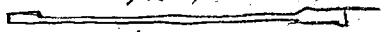
~~June 28~~ 1210 1211 1212 ~~1213~~	~~Palmetto~~ leaf 12 × 12 and 4 5/8 long ends where 5/32 wide put in large clamp
June 28 small clamp 1213 1214 large clamp 1215 1216	pouzis Bass Fibres or monkey ~~Bass~~ 12 × 12 and 4.5/8 long narrow ends 2 long clamps x 2 short clamps
June 28 1217 1218 1219 1220	Reglar Buss fibres
June 28 1221	~~Bass~~ Fibres 2 × 5/8 long 12/1000 × 12/1100 put in strait glass large clamp

14X

Lamps

June 28 1880

Chas Flammer

1222	carbon cut from willow 4x 5/8 long 
	12/1000 by 12/1000 
	got one out of 12 rest Broke in Carbonizing put in long clamp
1223 1224	Bass Fibres 5/1000 by 12/1000 and 4 5/8 long put in long clamp
1225	Bass Fibres Regular in extra large clamp
June 30	Bass Fibres
long 1226 long 1227 short 1228	5/100 by 12/1000 x 4 5/8 long 2 short and one long clamps

M/6

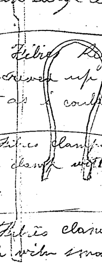
L

Lamps

July 1 1886 — 4

Chas Flammer

July 1	
1229 1230	2 Bass Fibres 10/1000 × 10/1000 by 4.5/8 long put in large clamps
July 1 1231 1232 1233 ~~1234~~	Bass Fibres Regular I screwed up clamp as tight as I could large clamp
July 2nd 1235 : 1237 1236 : 1238	Bass Fibres clamped very tight large clamp with large screw
July 7th 1239 } 1241 1240 } 1242	Bass Fibres clamped in large clamp with small screw clamped as tight as screw would alow
July 8 1243 1244	Bass Fibres 6 in long by 12/1000 × 12/1000 3/64 in ends put in large clamp



18 — July 8th 1886

148

Lamps

July 8 1880

Chas Flammer

1245	Regular Bass Fibre 4 5/8 long 8/1000 by 12/1000
July 8	amonia of salt small clamp Platnum
german glass 1246	Bass Fibres same as ~~of 1245~~ 6 in long 12/1000 + 12/1000 one is made of german glass one of Corning glass
Corning 1247 glass	
July 9th 1880 1248	made from bamboo 4 + 7/8 long 12/1000 + 12/1000 put in large clamp
1249 1250	2 Palmeto Fibres leaf Regular lenth put in large clamp
corning glass 1251 german glass 1252	Regular bass fibres lamp is made of diferent glass 1 German glass x 1 Corning "

150

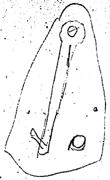
Lamps

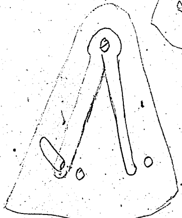
July 10/1880

Chas Flammer

1253	made from bamboo ~~taken~~ from ~~top~~ of a fan 4 5/8 long $\frac{12}{1000} \times \frac{12}{1000}$ put in large clamp
1254	made from Rye straw made pith on one side 4 5/8 long $\frac{12}{1000} \times \frac{12}{1000}$ put in large clamp
Broke after it was put in lamp in glass Blowers house	
1255	large Bass Fibre 6 in long $\frac{12}{1000} \times \frac{12}{1000}$ put in large clamp
1256	made from Palmetto leaf 4 5/8 long $\frac{12}{1000} \times \frac{12}{1000}$ put in large clamp

152

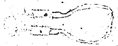




Lamp Edison's Exhibit (1) (page 153 book 57) J.F.R. notary / July 10 1880 153

Chas Flemming

1257
1258 2 regular Bass Fibres put in same as we put paper carbon in



old way of clamping

4 5/8 long $\frac{12}{1000} \times \frac{12}{1000}$

Edison's Exhibit 12 vs Swan
Edison Exhibit for Identification
March 28, 1884
W.H.C.
Witness

1259 made from paper
4 5/8 $\frac{12}{1000} \times \frac{12\frac{1}{2}}{1000}$
put in large clamp

1260 ~~Made~~ from Bamboo taken from top of a fan
4 5/8 long by $\frac{12}{1000} \times \frac{12}{1000}$

July 13

1261
1262
1263 made from Bamboo rod 4 5/8 long $\frac{12}{1000}$, $\frac{12}{1000}$ square
all for 2664 put in large clamp carbon was not very good

Lamps

1265 =	Carbonization No 1 Book 105 Page 23 Bast Fibre – ends dipped in solution of double Chloride NH4 and Pt before carbonizing
1266	Ditto
1267 1268 1269 1270	Ditto

4271 } 4272 }	– Bast fibres (carbonized) – ends dipped in Chl Pt – recarbonized – Platinum on them does not show very good guess it is platinum ~~[illegible]~~ black. ~~may not give very good results~~
4273	Regular Bamboo fibre – after putting in clamps I noticed both ends split length-wise –

1274 } Bast fibres (carb—)
1275 ends soaked in ~~Pt~~ Pt-Chl.
recarbonized — ends
dipped a second time
and recarb—

1276 Regular Bamboo fibre
1277 these are made with
fault in one side —
as per order 8 page 31
B 105 —

✓1278 ✓1279	Bast fibres — Carb — ends soaked in Chl Pt 3 times carbonizing after every time

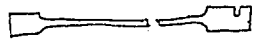
Edison — at 16 candles clamp part Carbn yellow — at 44 whitish yellow —

✓1280 ✓1281 ~~1282~~	Old Paper Carbons — — Carbonized — ends soaked in Chl. Pt. and recarbonized —

Note — Pt appears on them in black powder and persistently goes a short way up fibre although very careful to keep off when doing —

July 17-1880

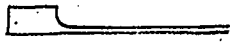
√1282 Bamboo fibres 12X12 m
√1283 Dipped in Chl Pt
√1284 and carbonized —
√1285

√1286 } Bamboo fibres
√1287 } 12X12 as usual but
ends so: 
ends $\frac{3}{32}$ in wide
some of the ends left above clamps

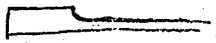
√1288 - Bass fibres - carbonized -
√1289 heated on plate - dipped
in boiling syrup carbonized finished
off afterwards by Edison -

1290 — Bamboo fibre 12×12 M

— ends $\frac{3}{32}$ wide —

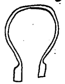
— shape  —

1291
1292 Bast fibres 12×12 M
carbonized — afterwards
slight amount of syrup on
ends and platinum foil
wrapped round ends

1293 broke
1294 Bamboo fibre 12×12
ends $\frac{3}{32}$ wide
shape 

July 19. 1880

1295 Bamboo 12 X 12 M
Carbonized flatways so:—

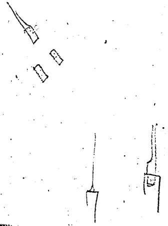


$\frac{3}{32}$ ends

1296 Bamboo 12X12 M (regular)
Carbonized flatways —
ends coated with platinum foil
previous to Carb— afterwards
the platinum seemed to have
come off but under microscope
it showed very finely divided
although in some places there
was not any.

July 19. 1880

✓1297 Broke	Bamboo 12×12 in Reg—ends coated with Pt foil before carbonizing—afterwards it looked silvery grey on ends and under Micro—showed very little of Pt.
one end split in clamping	
✓1298	Bamboo 12×12 Reg.—with fault in one side



July 19 1880

1299	Bamboo 12 X 12 Reg - Carbonized - - coated afterwards in clamp with Plat. Irid. 10% foil -
1300 1301 1302 1303 1304 ~~1305~~ Broke ~~1306~~ Broke	Bamboo 12 X 12 Regular
1307 1308 1309	Bamboo 12 X 12 made from the very thick bamboo - rather coarse

1310 Japanese Bamboo
1311 (Real) Reg 12X12
1312
1313
1314
~~1315~~

1315 = Reg. Japanese Bamboo
12X12 with platinum
wrapped round ends

July 22 80

1316 <u>Amaranth</u> 12 X 12 Reg
We had to soak this in
alcohol to be able to bend
it — When it came out
it looked whitish — Under
the micro. showed little
white spots — Altogether
considerably rougher than
Bamboo —

July 22

1317 Ordinary Bamboo
12 X 12 ends .020 thick
1/16 wide

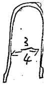
Turtle Wood after
carbonizing looks
very rough — large
crevasses. ~~filled~~ in them
with a whitish stuff —
— stringy looking —

1318	Amaranth 12X12 Reg.
1319 1320	White ~~[illegible]~~ Holley 12X12 Reg –
1321	Tulip wood 12X12 Reg
	Amaranth, White Holley and Tulip are not so coarse as Turtle wood but Coarser than Bamboo

July 24

1322	Real Bamboo
1323	Bast - Carbonized & Hydrocarboned in Kerosene by the Current -
1324	Bast brought up in Kerosene for insulation only —

July 26. 1880

1325	Manila fibre, treated in Kerosene.
1326	Treated in Kerosene
1327 / 1328	Made in new mould 12 X 12 Kg — straight — as wide 

1329	12X12 Bamboo-Reg- straight mould swimming in Kerosene
1330	12X12 Bamboo-Reg ~~Straight~~ mould 1 in wide carbonized with layers of Bituminous coal Under micro- surface is entirely covered with very fine powdered coal

July 28, 1880

1331 1in Wide Mould
25-m. ends
Bamboo 12 X 12.
Bituminous coal in
mould —

1332 1in Wide
25 ~~thousandst~~ ends.
Bamboo 12 X 12
Kerosene before and
after Carbonizing
Shows a ~~little~~ Carbon
deposited on it but
not very even

188

189

July 29

1333	1 in wide 12 X 12 Kerosene (Bamboo)
→Broke 1334 1335 ~~Broke~~	Regular Bamboo Jap. 12 X 12 — 25 M. ends —
1336	wide straight mould Bamboo 12 X 12 Reg a little tar in ends to keep from cracking
1337 1338	long 6 in fibre

July 30, 1880

1339
1340 Bast fibres — Carbonized — put in muffle and gasolene passed in at high heat.

1341 Bamboo 12 x 12 $\frac{3}{32}$ end — turned in

se

1342 Paper-Carbon

1343 — 1 long 6" Bamboo-Carb. put in receiver and ignited in gasolene vapor. Showed dull metallic lustre

1344 — Long bamboo 6 in.
1345 — turned it  —
1346
1347
1348
1349

1350 — ditto

Aug 2d 1880

1351 — Bamboo 12 x 12 6 in.
1352 — Inspected by Batchelor
1353 — previous to Carbonizing
1354 — all straight & good
1355
1356 — gas furnace
1357
1358

||||
|||

1359 to 1365	same as before
1366	6" Bamboo carbonized in gas furnace
1367 1368 1369 1370 1371 1372 1373 1374 1375 1376	6" Bamboo Carbonized in gas furnace

1377 Bamboo fibres 12 X 12
Carbonized with small moulds
heated over gas with one flame
under the clamp end

1378 Ditto
Heated under the round
end only ~~under~~ over gas.

1379 This was the bottom one
of a pile of nine that
were carbonized together
in gas furnace flatways
Running from 1 at ~~bottom~~
to 9 at top
They will all be put
into the clamp the

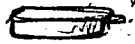
Same way so that when the heads of screws or clamps are up the carbon is in the same position that it laid in the mould

1380	No 2 of this lot
1381	No 4 of the lot
1382 ✓	— 5 —
1383	— 7 —
1384	— 8 —
1385	— 3 —
1386	— 6 —
1387	— 9 —

a no spots

a bad spot – broke

Bad spot
good light
poor vacuum

1388 to 1398	6 X 6 Bamboo Carbonized in new gas furnace
1399 a, b, c	3 different loops from top of gas furnace see page 63 Book 105 =
1400 a, b, c	Ditto from bottom — 63 page Book 105
1401	~~[illegible]~~ 1 put in  mould ~~muffle~~ 12 X 12 – 6 in — no previous heating — brought as high as possible not over a yellow in new gas furnace

Both bent

Bent some but not as much as 1408 + 9

1402 1403 1404	3 loops Exp. 1 page 61 Vol 105
1405	1 loop of Ex No 8 P 63 Vol 105
1406	1 loop of Ex No 2 P 61 Vol 105
1407	1 loop of Ex 8 P 63 Vol 105
1408 1409	No 9 exp. p 63 - Vol 105
1410 1411	No 10 exp p. 71 Vol 105

1412	Exp No 3 P 61 Vol 105
1413	Exp No 2 P 61 Vol 105
1414	Exp No 3 P 61 Vol 105
1415 1416	2 . 6" loops from out of gas ~~muffle~~ furnace brought up to high heat in muffle
1417 ~~1416~~	2 6 loops ~~for~~ heated on preliminary gas then brought just to red in furnace

1418	6 X 6 = 6" Bamboo
1419	Carbonized edgeways.
1420	
1421 ✓	
1422	
1423	
1424 ✓	
1425	
1426	
1427 ✓	
1428 ✓	
1429	
1430	
1431	
1432	
1433	
1434	
1435	
1436	These were carbonized by
1437	Van Cleve as the second
1438	mould full in Factory
1439	edgeways Aug 17th 1880

1440 Bast fibre 4 a —
Brought up in muffle in
gasolene gas

~~1441~~
~~1442~~
~~1443~~

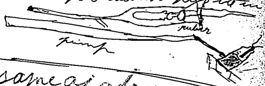
~~1444~~
~~1445~~
~~1446~~
~~1447~~
~~1448~~
~~1449~~

1441 these are same as on
1442 page 207 — 1436 to 1446
1443
1444 german glass
1445
1446

1447 1448 1449 1450 1451 12x12	these were carbonized by Van Cleve as the first mould full in Factory edgways Aug 17, 1880 german glass
1452 1453	Bamboo carb by Van Cleve in old Factory marked 8/1000 by 16/1000 Aug 18. 1880 german glass edge ways
1454 1455 1456	Bamboo Carb by Van Cleve in factory marked 9/1000 by 15/1000 Aug 18th 1880 german glass edge ways
ill wrinkled 1457 1458 one end longer than the other	same as lamps 1452 and 1453 Aug 18, 1880
1459 1456	Bamboo 9/1000 by 15/1000 same as 1454

~~1460~~

1461 Bamboo Carbon as first lot done in new factory to put it on test pump had bad spots did not put it in



1462 same as afore
this was not extra good but put it in

1463
1464 Bamboos long kind were brought up in test pump sho no spots nickel. Clamps with iron screws

rec of Van Cleve 18 carbons
marked regular

good ~~IIII~~ II

bad IIII

spoted IIII

Broke III

rec - 14 carbons sept - 11 1880

good bad Broke spoted

Sept 10. 1880

Chas Flammer

No. of lamps				
	rec 18 they where called	large carbons reg No 1		sept 10th 1880
	good	bad	spoted	Broke
	𝍸 𝍸	////	///	////
	10	4	3	4
	rec 14 these	carbons regular	sept 10th 1880 No 2	
	good	bad	spoted	broke
	𝍸 𝍸 //	0	///	//
	12		3	2
	rec 18 regulars	carbons No 3	sept	10 1880
	good	bad	spoted	broke
	𝍸 𝍸 ///	//	///	𝍸 //
	13	2	3	7
	rec 18 regulars	carbons No 4	sept 13th 1880	
	good	bad	spoted	broke
	𝍸 𝍸 𝍸	/	///	𝍸 /
	15	1	3	6
	rec 18 regulars	carbons No 5	sept 13th 1880	
	good	bad	spoted	broke
	𝍸 𝍸 𝍸 /	/	////	///
	16	1		

Chas Flammer

rec 20 regular good 𝍸 𝍸 𝍸 𝍸 20	carbons No 6 bad	sept spoted //	13th 1880 broke //// broke
rec 17 reglar good Platinum 𝍸 // 7 Nickel 𝍸 // 14 clean	carbons No 7 bad /	sept spoted nickel ///	14th 1880 broke ///
rec 18 reglar good 𝍸 𝍸 𝍸 /// 18 nickel clamp	carbons No 8 bad //	sept spoted ///	14 1880 broke ///
rec 20 reglar good 𝍸 𝍸 𝍸 ///	carbons No 9 bad /	sept spoted 𝍸	14 1880 broke //
rec 20 regular good 𝍸 𝍸 𝍸 /// 18	~~carbons~~ carbons No 10 bad /	sept 15 spoted 𝍸 ///	1880 broke 𝍸 /

Regulars No 11 Chas Flammer

rec 20	large	carbons	of ~~[illegible]~~
Vaullen	regular no 11 Sept	15th	1880
good	bad	spoted	broke
1111 1111	1		

No 1 Contraction is twisted
so as flow is not straight

Experiments with pumps

No 1 Has Contraction 2 m m
fall tube 5 m m
outside 9
Runs through $14\frac{1}{4}$ lb. per min

No 2 Has Contraction 2 m m
fall tube 4 m m
outside 7 m m

No 3	Has Contraction	1.5 mm
	fall tube	.4 mm
	outside	.7 mm
	Runs through	

Oct 21st 1880

Pumps No 1

Contraction —

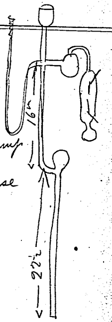
Fall tube —

Runs Mercury per minute in Vacuo

Oct 20. got Vacuum 41 min without Lamp

Oct 21. Could not get Vacuum as Hg went back without cause

took down



Oct 21st 1880

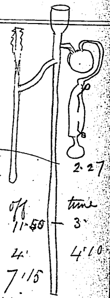
Pump No 2

Contraction

Fall tube

Runs 2" Hg per min in Vacuo

Strikes 5 in down



Lamp 1 { ~~Started~~ Spark left 40 min.
Sealed off 2.27 min — 2.27

Lamp 2 ~~Sealed off~~ 1 hour 58.

3 — Broke on first heat

	Put on	Spark left	off	time
4	8.50	10-05	11-50	3.
5	11-50		4.	4'10
6	4 05		7'15	
7	7'34 broke by current rising			
8	9.23		11'49	
9	8-15 sealed off		11'15	
10	11.21			

8.13 — 10 27
10 34 — 2-33
2 38 — 4 30
4 10 — 7 28
1 25 — 4 57
8 25 — 11.10
7 30 — 11 20

Oct 21st 1880

Pump No 3 same as no 2

Contraction

Fall Tube

Runs Hg per min

Strikes down

Lamp 1 – put on 4:04 Spark gone + taken off at 6 o'clock Mix

2 – 7-40 Spark gone 10.50 Sealed off 11-15 3-35

3 11 15 4' 4'15

pump Broke in handling

Pump No 4
Pump gives $3\frac{1}{2}$ g per min in Vacuum

Put on	Spark Off	Off	time
8.50 —	11-45 —	4'45	
4'40 —	—	9-30	
8.45	Broke. 135		
1 40			
8.17	2.20		

No 5

Put on	Spark left	off	time
11-20	did not get vacuum		

No 6

Runs through

Started	off
3.20	9.30
9.38	Broke by current
11.20	2 55
2-58	
818	carbon broke 958
10.10	2.15
2.19	4.23
1 40	4 08

No 7

Started	left	Off
4:27		7-15
7:25		11-49
8.19		11 44
11.45		
8:14	10 27	
10 34	2 30	
2 34	4:57	
8 24	11.20	

Pump No. 8.

Started	Off
5.08	9.30
9-38	11-35
8 15	Bright spot and abandoned 9 23

8 30	Broke Current 9.15
9 20	Sealed off 1.27
1.30	
10 50	2.21
2 23	Bad spot 320

8 20	11 49
11 54	2 24
2 30	24 58
8 22	11 40

 Bore of fall tube ·1.05

8.26	
2 25	Broke 445
8 22	545 Hg vapor

8 4.0	2 4 0
2 4 2	
5 0 6	7 44
10 3 8	1 3 0
8 3 0	10 35
7.3 0	9.42

8.58	In vacuum 10'
11.05	
8 35	3 15
7 30	10 05

252

14 $\frac{18}{97}$ 253

8·48	
4·21	455
8 35	257

254

15.

14
99

255

8.55	11.45 Broke by Current
11 44	
8 35	2.00

256

16

$\frac{21}{103}$

257

9'05	118
1 20	
8 35	11 33

17

16
114

7.30	10.35

260

18 $\frac{16}{113}$ 261

yes sir

~~Ling~~

Aedlove 2

$\frac{16}{106}$

244

20

$\frac{16}{116}$

245

2ee

21

$\frac{16}{87}$

267

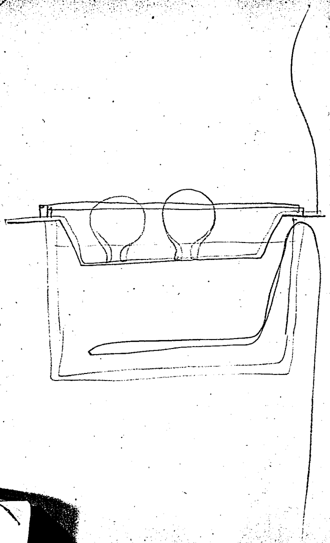
7.30	11.50

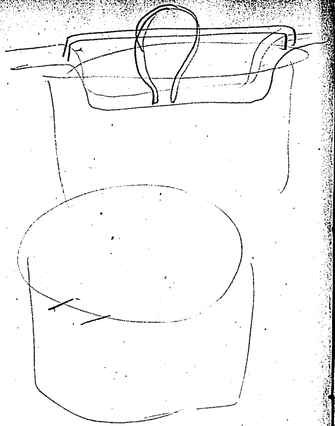
288

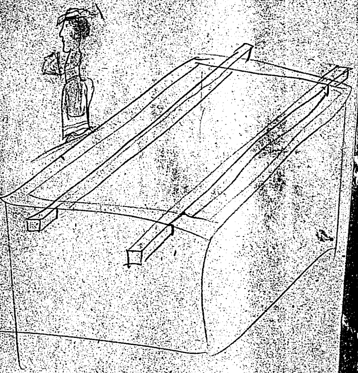
22

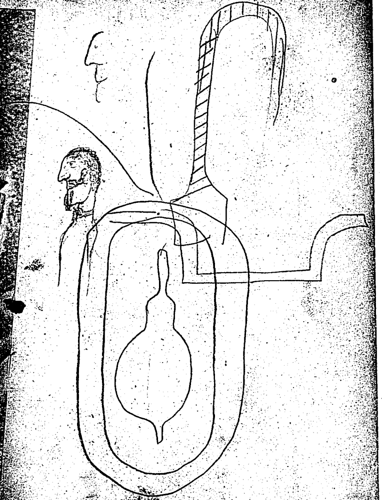
21/131

269









Menlo Park Notebook #58 [N-80-01-31]

This notebook covers the period January-February 1880. The entries are by Charles L. Clarke and relate primarily to copper conductors for electric lighting. The name "Clarke" is inscribed on the inside front cover. The book contains 284 numbered pages. Pages 94-265 consist of skeleton tables that were never filled in. These have not been filmed.

Blank pages not filmed: 68-69, 266-273.

× E-172 N-80-01-31

Clarke.

1

Jan. 31, 1880.

D'Aubuisson's Hydraulics

Water at 60° F weighs 62,39 lbs. per cubic foot.

Specific gr. of Copper as given by Clark and Sabine "according to best authorities" is 8.899.

Weight of cubic foot of copper therefore is 555.2 lbs, and will be assumed as 555 lbs. This is the weight given by Molesworth but other authorities vary, Sprague also gives it as 555 lbs. per cu. ft.

2

By Dr. Matthiessen the resistance of chemically pure annealed copper wire per grain-foot is .2064 ohms. at 0°C.

This assumes the conductivity as 100, assuming it to be 97, the resistance per foot-grain is .2127835 Ohms, at 0°C.

To reduce this to resistance at 60°F or $15\frac{5}{9}$°C apply Matthiessen's formula

$$R = r(1 + at + bt^2),$$

$$R = .2127835\left\{1 + 15\tfrac{5}{9}(.003824) + \left(15\tfrac{5}{9}\right)^2 .00000126\right\}$$

$$R = .2127835\left\{1 + .0594844\tfrac{4}{9} + .00030488\tfrac{22}{81}\right\},$$

$$R = .2127835\left(1.059789\tfrac{1}{3}\right),$$

3

R = .2255 Ohms per grain-foot, at 60°F with copper having a conductivity of 97.

$\frac{1.0000}{.2255} = \underline{4.434589}$ is the no. of feet of grain-foot wire giving a resistance of one ohm.

$\pi = 3.14159265$

.0000007853981625 = area of 1 mil in sq. in.

.000009424777995 = Contents of mil-foot in cu. in.

.000000005454415 = Contents of mil-foot in cu. ft.

× 555 =

.00000302705325 = Weight of mil-foot in lbs.

× 7000 =

.02118937275 = Weight of mil-foot in grains.

We have then the weight of mil-foot in grains $= .02118937275$, then in one grain-foot there will be 47.193469 mil-feet.

As the resistance per grain-foot $= .2255$ ohms (page 3), the resistance per mil-foot $=$

$.2255(47.193469) =$

$10.64212725 95$ Ohms.

This last result is the quotient of $\frac{U}{M}$ in which $M = .02118937275$ grains and $U = .2255$ ohms (See Sprague, page 182).

We then have

$$R = 10.6421272595 \frac{l}{d^2}.$$

$$\therefore d = \sqrt{\frac{(10.6421272595)l}{R}}$$

$=$ diameter in mils.

Weight per foot in grains $= w = d^2 M$ $\therefore$ weight of a length l will be

$$W = d^2 M l,$$

$$W = .021189\, d^2 l, \text{ in grains.}$$

$$W = .000003027\, d^2 l, \text{ in lbs.}$$

Using the formula on page 4

$$d = \sqrt{\frac{(10.6421272595)l}{R}}$$

we have when:—

$R = \frac{1}{2}$ ohm,

$d^2 = 21.2842545190\, l,$

$d = 4.613486 \sqrt{l}.$

When $R = 1$ ohm,

$d^2 = 10.6421272595\, l,$

$d = 3.26223 \sqrt{l},$

When $R = 1\frac{1}{2}$ ohms.

$d^2 = 7.094750\, l.$

$d = 2.6636 \sqrt{l},$

6

When $R = 2$ ohms,

$Z^2 = 5.3210636297\,l$,

$Z = 2.306743\sqrt{l}$.

When $R = 2\frac{1}{2}$ ohms,

$Z^2 = 4.2568509038\,l$,

$Z = 2.0632137\sqrt{l}$.

When $R = 3$ ohms

$Z^2 = 3.5473757538\,l$.

$Z = 1.88345\sqrt{l}$.

When $R = 3\frac{1}{2}$ ohms.

$Z^2 = 3.0406077888\,l$,

$Z = 1.74373\sqrt{l}$,

When $R = 4$ ohms.

$Z^2 = 2.6605318148\,7l$,

$Z = 1.631115\sqrt{l}$,

When $R = 4\frac{1}{2}$ ohms,

$Z^2 = 2.364917169\,l$,

$Z = 1.53783\sqrt{l}$.

7

When $R = 5$ ohms,

$Z^2 = 2.1284254519\,l$,

$Z = 1.45891\sqrt{l}$,

When $R = 6$ ohms,

$Z^2 = 1.7736878766\,l$,

$Z = 1.33179\sqrt{l}$,

When $R = 7$ ohms,

$Z^2 = 1.5203038956\,l$,

$Z = 1.23298\sqrt{l}$,

When $R = 8$ ohms,

$Z^2 = 1.3302659074\,l$,

$Z = 1.153483\sqrt{l}$,

When $R = 9$ ohms,

$Z^2 = 1.1824585844\,l$,

$Z = 1.08741\sqrt{l}$,

When $R = 10$ ohms,

$Z^2 = 1.06421272595\,l$,

$Z = 1.0316\sqrt{l}$,

Page 5 we have the weight of any length of wire

$W = .000003027\ I^2 l$, in lbs.

Substituting the values of I^2 which have just been given we have

When R = ½ ohm,

$W = .0000644274 l^2$, in lbs.

When R = 1 ohm,

$W = .0000322137 l^2$, in lbs.

When R = 1½ ohms,

$W = .0000214758 l^2$, in lbs.

When R = 2 ohms,

$W = .0000161068 l^2$, in lbs.

When R = 2½ ohms,

$W = .000012885 l^2$, in lbs.

When R = 3 ohms,

$W = .0000107379 l^2$, in lbs.

When R = 4 ohms,

$W = .00000805343 l^2$, in lbs.

When R = 5 ohms,

$W = .00000644274 l^2$, in lbs.

When R = 6 ohms,

$W = .000005369\ l^2$, in lbs.

When R = 7 ohms,

$W = .0000046020 l^2$, in lbs.

When R = 8 ohms,

$W = .0000040267\ l^2$, in lbs.

When R = 9 ohms,

$W = .0000035793\ l^2$, in lbs.

When R = 10 ohms,

$W = .00000322137 l^2$, in lbs.

In order to facilitate calculation of the tables the values of d will be taken only to four decimal places, and the values of W will be taken only to the first four digits. We then have for the values of d and W by which these tables are made:-

		logarithms of constants.
$R = \frac{1}{2}$ ohm	$d = 4.6135\sqrt{l}$,	0.66403
	$W = .00006443\, l^2$.	$\bar{5}.80909$
$R = 1$ ohm	$d = 3.2622\sqrt{l}$,	0.51351
	$W = .00003221\, l^2$,	$\bar{5}.50799$
$R = 1\frac{1}{2}$ ohms	$d = 2.6636\sqrt{l}$.	0.42547
	$W = .00002148\, l^2$.	$\bar{5}.33203$
$R = 2$ ohms	$d = 2.3067\sqrt{l}$,	0.36299
	$W = .00001611\, l^2$;	$\bar{5}.20710$
$R = 2\frac{1}{2}$ ohms	$d = 2.0632\sqrt{l}$,	0.31454
	$W = .00001289\, l^2$,	$\bar{5}.11025$
$R = 3$ ohms	$d = 1.8835\sqrt{l}$,	0.27497
	$W = .00001074\, l^2$,	$\bar{5}.03100$
$R = 4$ ohms	$d = 1.6311\sqrt{l}$.	0.21248
	$W = .000008053\, l^2$.	$\bar{6}.90596$
$R = 5$ ohms	$d = 1.4589\sqrt{l}$.	0.16403
	$W = .000006443\, l^2$.	$\bar{6}.80909$
$R = 6$ ohms	$d = 1.3318\sqrt{l}$.	0.12444
	$W = .000005369\, l^2$,	$\bar{6}.72989$
$R = 7$ ohms	$d = 1.2330\sqrt{l}$,	0.09096
	$W = .000004602\, l^2$	$\bar{6}.66295$
$R = 8$ ohms	$d = 1.1535\sqrt{l}$,	0.06202
	$W = .000004027\, l^2$	$\bar{6}.60498$
$R = 9$ ohms	$d = 1.0874\sqrt{l}$,	0.03639
	$W = .000003579\, l^2$.	$\bar{6}.55976$
$R = 10$ ohms	$d = 1.0316\sqrt{l}$.	0.01351
	$W = .000003221\, l^2$	$\bar{6}.50799$

d will be in thousandths of an inch. l is in feet, W in lbs.

½ Ohm Resistance

Distance	Length of Bond	Diam. inches	Area sq. in.	Weight per foot lbs.	Total Weight lbs.	Cost
20 ft.	40 ft.	.029	.0007	.0026	.103	
40	80	.041	.0013	.0051	.413	
60	120	.051	.0020	.0077	.928	
80	160	.058	.0027	.0103	1,650	
100	200	.065	.0033	.0129	2,577	
120	240	.072	.0040	.0155	3,711	
140	280	.077	.0047	.0180	5,051	
160	320	.083	.0053	.0206	6,598	
180	360	.088	.0060	.0232	8,350	
200	400	.092	.0067	.0258	10,309	
220	440	.097	.0073	.0283	12,473	
240	480	.101	.0080	.0309	14,845	
260	520	.105	.0087	.0335	17,421	
280	560	.109	.0094	.0361	20,205	
300	600	.113	.0100	.0387	23,195	

1 Ohm Resistance

Diam.	Area	Weight per foot	Total Weight	Cost
.021	.0003	.0013	.052	
.029	.0007	.0026	.206	
.036	.0010	.0039	.464	
.041	.0013	.0052	.825	
.046	.0017	.0065	1,289	
.051	.0020	.0078	1,855	
.055	.0023	.0090	2,525	
.058	.0027	.0103	3,298	
.062	.0030	.0116	4,174	
.065	.0033	.0129	5,154	
.068	.0037	.0142	6,236	
.072	.0040	.0155	7,421	
.074	.0044	.0168	8,710	
.077	.0047	.0180	10,101	
.080	.0050	.0193	11,596	

1½ Ohms Resistance

	Diam.	Area.	Weight per foot	Total Weight	Cost
20	.017	.0002	.0009	.034	
40	.024	.0004	.0017	.138	
60	.029	.0007	.0026	.309	
80	.034	.0009	.0034	.550	
100	.038	.0011	.0043	.859	
120	.041	.0013	.0052	1.237	
140	.045	.0016	.0060	1.684	
160	.048	.0018	.0069	2.200	
180	.051	.0020	.0077	2.784	
200	.053	.0022	.0086	3.437	
220	.056	.0025	.0095	4.159	
240	.058	.0027	.0103	4.949	
260	.061	.0029	.0112	5.808	
280	.063	.0031	.0120	6.736	
300	.065	.0033	.0129	7.733	

2 Ohms Resistance

Diam.	Area.	Weight per foot	Total Weight	Cost
.015	.0002	.0007	.026	
.021	.0003	.0013	.103	
.025	.0005	.0019	.232	
.029	.0007	.0026	.412	
.033	.0008	.0032	.644	
.036	.0010	.0039	.928	
.039	.0012	.0045	1.263	
.041	.0013	.0052	1.650	
.044	.0015	.0058	2.088	
.046	.0017	.0065	2.578	
.048	.0018	.0071	3.119	
.051	.0020	.0077	3.712	
.053	.0022	.0084	4.356	
.055	.0023	.0090	5.052	
.057	.0025	.0097	5.800	

2½ Ohms Resistance

	Diam.	Area.	Weight per foot.	Total Weight.	Cost.
20	.013	.0001	.0005	.021	
40	.019	.0003	.0010	.083	
60	.023	.0004	.0016	.186	
80	.026	.0005	.0021	.330	
100	.029	.0007	.0026	.516	
120	.032	.0008	.0031	.743	
140	.035	.0009	.0036	1.011	
160	.037	.0011	.0041	1.320	
180	.039	.0012	.0046	1.671	
200	.041	.0013	.0052	2,062	
220	.043	.0015	.0057	2,496	
240	.045	.0016	.0062	2,970	
260	.047	.0017	.0067	3,484	
280	.049	.0019	.0072	4.042	
300	.051	.0020	.0077	4.640	

3 Ohms Resistance.

Diam.	Area.	Weight per foot.	Total Weight.	Cost.
.012	.0001	.0004	.017	
.017	.0002	.0009	.069	
.021	.0003	.0013	.155	
.024	.0004	.0017	.275	
.026	.0005	.0021	.430	
.029	.0007	.0025	.619	
.032	.0008	.0030	.842	
.034	.0009	.0034	1.101	
.036	.0010	.0039	1.392	
.038	.0011	.0043	1.718	
.040	.0012	.0047	2.079	
.041	.0013	.0052	2,475	
.043	.0015	.0056	2,904	
.045	.0016	.0060	3,368	
.046	.0017	.0064	3,866	

4 Ohms Resistance.

	Diam.	Area.	Weight per foot	Total Weight	Cost
20	.010	,00008	.0003	,013	
40	.015	,00016	,0006	,052	
60	,019	,00026	,0010	,116	
80	,021	,00034	,0013	,206	
100	,023	,00042	,0016	,323	
120	,025	,00049	,0019	,464	
140	,027	,00057	,0022	,631	
160	,029	,00067	,0026	,825	
180	,031	,00075	,0029	1,044	
200	,033	,00083	,0032	1,289	
220	,034	,00091	,0035	1,559	
240	,036	,00101	,0039	1,855	
260	,037	,00109	,0042	2,178	
280	,039	,00117	,0045	2,525	
300	,040	,00125	,0048	2,899	

5 Ohms Resistance

Diam.	Area	Weight per foot	Total Weight	Cost.
.009	,00008	,0003	,010	
,013	,00013	,0005	,041	
,016	,00021	,0008	,093	
,019	,00026	,0010	,165	
,021	,00034	,0013	,258	
,023	,00042	,0016	,371	
,024	,00047	,0018	,505	
,026	,00054	,0021	,660	
,028	,00060	,0023	,835	
,029	,00067	,0026	1,031	
,031	,00073	,0028	1,247	
,032	,00080	,0031	1,485	
,034	,00088	,0034	1,742	
,035	,00093	,0036	2,021	
,036	,00101	,0039	2,320	

6 Ohms Resistance.

	Diam.	Area.	Weight per foot.	Total Weight.	Cost.
20	,008	,00005	,0002	,009	
40	,012	,00010	,0004	,034	
60	,015	,00016	,0006	,077	
80	,017	,00023	,0009	,138	
100	,019	,00026	,0010	,215	
120	,021	,00034	,0013	,309	
140	,022	,00040	,0015	,421	
160	,024	,00044	,0017	,550	
180	,025	,00049	,0019	,696	
200	,027	,00057	,0022	,859	
220	,028	,00062	,0024	1,039	
240	,029	,00067	,0026	1,237	
260	,030	,00073	,0028	1,452	
280	,032	,00078	,0030	1,684	
300	,033	,00083	,0032	1,933	

7 Ohms Resistance.

Diam.	Area.	Weight per foot.	Total Weight.	Cost.
,008	,00005	,0002	,007	
,011	,00010	,0004	,029	
,015	,00016	,0006	,066	
,016	,00018	,0007	,118	
,017	,00023	,0009	,184	
,020	,00029	,0011	,265	
,021	,00034	,0013	,361	
,022	,00039	,0015	,471	
,024	,00044	,0017	,596	
,025	,00047	,0018	,736	
,026	,00052	,0020	,891	
,027	,00057	,0022	1,060	
,028	,00062	,0024	1,244	
,029	,00067	,0026	1,443	
,031	,00073	,0028	1,657	

8 Ohms Resistance

	Diam.	Area.	Weight per foot.	Total Weight.	Cost
20	,007	,00005	,0002	,006	
40	,010	,00008	,0003	,026	
60	,013	,00013	,0005	,058	
80	,014	,00016	,0006	,103	
100	,016	,00021	,0008	,161	
120	,019	,00026	,0010	,232	
140	,020	,00029	,0011	,316	
160	,021	,00034	,0013	,412	
180	,022	,00040	,0015	,522	
200	,023	,00042	,0016	,644	
220	,024	,00047	,0018	,780	
240	,025	,00049	,0019	,928	
260	,026	,00054	,0021	1,089	
280	,028	,00060	,0023	1,263	
300	,028	,00062	,0024	1,450	

9 Ohms Resistance

Diam	Area	Weight per foot.	Total Weight	Cost.
,007	,00003	,0001	,006	
,010	,00008	,0003	,023	
,012	,00010	,0004	,052	
,014	,00016	,0006	,093	
,015	,00018	,0007	,145	
,017	,00023	,0009	,209	
,019	,00026	,0010	,285	
,020	,00029	,0011	,372	
,021	,00034	,0013	,470	
,022	,00036	,0014	,581	
,023	,00042	,0016	,703	
,024	,00044	,0017	,836	
,025	,00049	,0019	,981	
,026	,00052	,0020	1,138	
,026	,00054	,0021	1,306	

10 Ohm Resistance.

	Diam.	Area.	Weight per foot.	Total Weight	Cost.
20	.0065	.00003	.0001	.005	
40	.009	.00008	.0003	.021	
60	.012	.00010	.0004	.046	
80	.013	.00013	.0005	.083	
100	.015	.00018	.0007	.129	
120	.016	.00021	.0008	.186	
140	.017	.00023	.0009	.253	
160	.019	.00026	.0010	.330	
180	.020	.00031	.0012	.417	
200	.021	.00034	.0013	.515	
220	.022	.00036	.0014	.624	
240	.023	.00042	.0016	.742	
260	.024	.00044	.0017	.871	
280	.024	.00047	.0018	1.010	
300	.025	.00049	.0019	1.160	

½ Ohm Resistance

Distance	Length of Cond.	Diam.	Area.	Weight per foot:	Total Weight	Cost
320	640	.117		.0412	26.392	
340	680	.120		.0438	29.793	
360	720	.125		.0464	33.400	
380	760	.127		.0490	37.215	
400	800	.130		.0515	41.236	
420	840	.134		.0541	45.452	
440	880	.137		.0567	49.892	
460	920	.140		.0593	54.534	
480	960	.143		.0619	59.380	
500	1000	.146		.0644	64.431	
520	1040	.149		.0670	69.684	
540	1080	.152		.0696	75.151	
560	1120	.154		.0721	80.820	
580	1160	.157		.0747	86.676	
600	1200	.160		.0773	92.780	

Feb. 4th 1880

1 Ohm Resistance

Diam.	Area.	Weight per foot.	Total Weight.	Cost.
.083	.0053	.0206	13.192	
.085		.0219	14.894	
.088	.0060	.0232	16.696	
.090		.0245	18.605	
.092	.0067	.0258	20.616	
.095		.0271	22.722	
.096		.0284	24.944	
.099		.0297	27.262	
.102		.0310	29.684	
.103		.0322	32.210	
.105	.0087	.0335	34.840	
.107		.0348	37.569	
.109		.0361	40.404	
.111		.0374	43.331	
.113	.0100	.0387	46.384	

1 1/2 Ohms Resistance

Diam.	Area.	Weight per foot.	Total Weight	Cost.
320 .068		.0137	8,800	
340 .070		.0146	9,932	
360 .072	.0040	.0155	11,136	
380 .073		.0163	12,398	
400 .075		.0172	13,748	
420 .077	.0047	.0180	15,153	
440 .079		.0189	16,636	
460 .081		.0198	18,181	
450 .083	.0053	.0206	19,796	
500 .084		.0215	21,480	
520 .086		.0223	23,232	
540 .088	.0060	.0232	25,054	
560 .089		.0240	26,944	
580 .091		.0249	28,896	
600 .092	.0067	.0258	30,932	

2 Ohms Resistance

Diam.	Area.	Weight per foot.	Total Weight	Cost.
.058	.0027	.0103	6,600	
.060		.0110	7,449	
.062	.0030	.0116	8,352	
.064		.0123	9,305	
.065	.0033	.0129	10,312	
.067		.0135	11,365	
.068	.0037	.0142	12,476	
.070		.0148	13,636	
.072	.0040	.0155	14,848	
.073		.0161	16,111	
.074	.0044	.0168	17,424	
.076		.0174	18,791	
.077	.0047	.0180	20,208	
.079		.0187	21,672	
.081		.0194	23,200	

2 1/2 Ohms Resistance

	Diam.	Area.	Weight per foot	Total Weight	Cost.
320	.052		.0082	5,280	
340	.054		.0088	5,960	
360	.055		.0093	6,684	
380	.057		.0098	7,445	
400	.058	.0027	.0103	8,248	
420	.060		.0108	9,093	
440	.061		.0113	9,984	
460	.063		.0119	10,910	
480	.064		.0124	11,880	
500	.065	.0033	.0129	12,890	
520	.067		.0134	13,936	
540	.068		.0139	15,035	
560	.069		.0144	16,168	
580	.070		.0149	17,341	
600	.072	.0040	.0155	18,560	

3 Ohms Resistance

Diam.	Area.	Weight per foot.	Total Weight	Cost.
.048	.0018	.0069	4,404	
.049	.0019	.0073	4,966	
.051	.0020	.0077	5,568	
.052	.0021	.0082	6,204	
.053	.0022	.0086	6,872	
.055	.0023	.0090	7,576	
.056	.0025	.0095	8,316	
.057	.0026	.0099	9,090	
.058	.0027	.0103	9,900	
.060	.0028	.0107	10,740	
.061	.0029	.0112	11,616	
.062	.0030	.0116	12,527	
.063	.0031	.0120	13,472	
.064	.0032	.0125	14,448	
.065	.0033	.0129	15,464	

4 Ohms Resistance

Diam.	Area	Weight per foot.	Total Weight	Cost
320 .041	.0013	.0052	3,300	
340 .043	.0014	.0055	3,724	
360 .044	.0015	.0058	4,176	
380 .045	.0016	.0061	4,652	
400 .046	.0017	.0065	5,156	
420 .047		.0068	5,681	
440 .048	.0018	.0071	6,236	
460 .050	.0019	.0074	6,816	
480 .051	.0020	.0078	7,420	
500 .052	.0021	.0081	8,053	
520 .053	.0022	.0084	8,712	
540 .054		.0087	9,393	
560 .055	.0023	.0090	10,100	
580 .056	.0024	.0093	10,834	
600 .057	.0025	.0097	11,596	

5 Ohms Resistance

Diam.	Area.	Weight per foot.	Total Weight	Cost.
.037	.0011	.0041	2,640	
.038		.0044	2,979	
.039	.0012	.0046	3,340	
.040		.0049	3,722	
.041	.0013	.0052	4,156	
.042	.0014	.0054	4,545	
.043	.0015	.0057	4,988	
.044		.0059	5,453	
.045	.0016	.0062	5,940	
.046	.0017	.0064	6,443	
.047	.0017	.0067	6,968	
.048	.0018	.0070	7,515	
.049	.0019	.0072	8,084	
.050		.0075	8,668	
.051	.0020	.0077	9,280	

6 Ohms Resistance

	Diam.	Area.	Weight per foot.	Total Weight.	Cost.
320	.034	.0009	.0034	2,200	
340	.035		.0037	2,483	
360	.036	.0010	.0039	2,784	
380	.037		.0041	3,101	
400	.038	.0011	.0043	3,436	
420	.039	.0012	.0045	3,788	
440	.040	.0012	.0047	4,156	
460	.040		.0050	4,537	
480	.041	.0013	.0052	4,948	
500	.042	.0014	.0054	5,369	
520	.043	.0015	.0056	5,808	
540	.044	.0015	.0058	6,262	
560	.045	.0016	.0060	6,736	
580	.045	.0016	.0062	7,223	
600	.046	.0017	.0065	7,732	

7 Ohms Resistance

Diam.	Area.	Weight per foot.	Total Weight.	Cost.
.031 Only	.0008	.0029	1,884	
.032	.0008	.0031	2,128	
.033		.0033	2,384	
.034	.0009	.0035	2,658	
.035		.0037	2,944	
.036	.0010	.0039	3,247	
.037	.0011	.0041	3,564	
.037	.0011	.0042	3,895	
.038		.0044	4,240	
.039	.0012	.0046	4,602	
.040		.0048	4,976	
.041		.0050	5,368	
.041	.0013	.0052	5,772	
.042		.0053	6,167	
.042		.0055	6,628	

8 Ohms Resistance

	Diam.	Area	Weight per foot	Total Weight	Cost
320	.029	.0007	.0026	1,648	
340	.030		.0027	1,862	
360	.031	.0008	.0029	2,088	
380	.032	.0008	.0031	2,326	
400	.033	.0008	.0032	2,576	
420	.034	.0009	.0034	2,841	
440	.035	.0009	.0036	3,120	
460	.035		.0037	3,408	
480	.036	.0010	.0039	3,712	
500	.037		.0040	4,027	
520	.037	.0011	.0042	4,356	
540	.038		.0044	4,697	
560	.039	.0012	.0045	5,052	
580	.039		.0047	5,417	
600	.040	.0013	.0048	5,800	

9 Ohms Resistance

Diam.	Area	Weight per foot	Total Weight	Cost
.028	.0006	.0023	1,488	
.028	.0006	.0024	1,678	
.029	.0007	.0026	1,880	
.030		.0027	2,096	
.031		.0029	2,324	
.032	.0008	.0030	2,560	
.033	.0008	.0032	2,812	
.033		.0033	3,071	
.034	.0009	.0035	3,344	
.034	.0009	.0036	3,629	
.035		.0037	3,924	
.036	.0010	.0039	4,233	
.037		.0040	4,552	
.037	.0011	.0042	4,882	
.038		.0043	5,224	

10 Ohms Resistance

	Diam.	Area.	Weight per foot	Total Weight	Cost.
320	,026	,0005	,0021	1,320	
340	,027	,0006	,0022	1,490	
360	,028	,0006	,0023	1,668	
380	,029	,0007	,0025	1,861	
400	,029	,0007	,0026	2,060	
420	,030	,0007	,0027	2,272	
440	,030	,0007	,0028	2,496	
460	,032	,0008	,0030	2,726	
480	,032	,0008	,0031	2,968	
500	,033	,0008	,0032	3,221	
520	,034	,0009	,0034	3,484	
540	,034	,0009	,0035	3,757	
560	,035	,0009	,0036	4,040	
580	,035	"	,0037	4,333	
600	,036	,0010	,0039	4,640	

1/2 Ohm Resistance

Distance	Length of Cond.	Diam.	Area.	Weight per foot.	Total Weight	Cost.
620	1240	.163		.0799	99,067	
640	1280	,165		,0825	105,565	
660	1320	,168		,0850	112,263	
680	1360	,170		,0876	119,170	
700	1400	,173		,0902	126,287	
720	1440	,175		,0928	133,603	
740	1480	,178		,0954	141,128	
760	1520	,180		,0979	148,860	
780	1560	,182		,1005	156,798	
800	1600	,185		,1030	164,949	
820	1640	,187		,1056	173,292	
840	1680	,189		,1082	181,848	
860	1720	,191		,1108	190,611	
880	1760	,194		,1134	199,579	
900	1800	,196		,1160	208,754	

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1 Ohm Resistance.

Diam.	Area.	Weight per foot.	Total Weight	Cost.
,115		,0400	49,526	
,117		,0413	52,772	
,119		,0425	56,123	
,120		,0438	59,576	
,122		,0451	63,144	
,124		,0464	66,802	
,126		,0477	70,564	
,127		,0490	74,430	
,129		,0503	78,399	
,131		,0515	82,475	
,132		,0528	86,646	
,134		,0541	90,924	
,135		,0554	95,306	
,137		,0567	99,790	
,138		,0580	104,377	

1½ Ohms Resistance

Diam.	Area	Weight per foot	Total Weight	Cost.
.094		.0266	33.027	
.095		.0275	35.193	
.097		.0283	37.427	
.098		.0292	39.729	
.100		.0301	42.096	
.101		.0309	44.534	
.103		.0318	47.043	
.104		.0326	49.620	
.105		.0335	52.266	
.107		.0343	54.983	
.108		.0352	57.764	
.109		.0361	60.616	
.111		.0369	63.537	
.112		.0378	66.526	
.113		.0387	69.585	

2 Ohms Resistance

Diam.	Area.	Weight per foot.	Total Weight.	Cost.
.081		.0200	24.771	
.083		.0206	26.395	
.084		.0213	28.070	
.085		.0219	29.798	
.086		.0226	31.572	
.088		.0232	33.401	
.089		.0239	35.282	
.090		.0245	37.215	
.091		.0251	39.200	
.092		.0258	41.237	
.093		.0264	43.323	
.095		.0271	45.462	
.096		.0277	47.903	
.097		.0284	49.895	
.098		.0290	52.189	

2½ Ohms Resistance

Diam.	Area.	Weight per foot.	Total Weight	Cost
,073		,0160	19,820	
,074		,0165	21,119	
,075		,0170	22,459	
,076		,0175	23,842	
,077		,0180	25,257	
,078		,0186	26,721	
,079		,0191	28,226	
,080		,0196	29,772	
,082		,0201	31,360	
,083		,0206	32,990	
,084		,0211	34,658	
,085		,0216	36,370	
,086		,0222	38,122	
,087		,0227	39,916	
,088		,0232	41,751	

3 Ohms Resistance

Diam.	Area.	Weight per foot.	Total Weight	Cost.
,066		,0133	16,514	
,067		,0138	17,596	
,068		,0142	18,714	
,070		,0146	19,875	
,071		,0150	21,048	
,071		,0155	22,267	
,073		,0159	23,521	
,073		,0163	24,810	
,074		,0168	26,133	
,075		,0172	27,492	
,076		,0176	28,882	
,077		,0180	30,308	
,078		,0185	31,769	
,079		,0189	33,263	
,080		,0193	34,792	

4 Ohms Resistance.

Diam.	Area.	Weight per foot.	Total Weight.	Cost.
.057		.0100	12,383	
.058		.0103	13,194	
.059		.0106	14,032	
.060		.0170	14,895	
.061		.0113	15,786	
.062		.0116	16,700	
.063		.0119	17,541	
.064		.0123	18,608	
.064		.0126	19,600	
.065		.0129	20,619	
.066		.0132	21,662	
.067		.0135	22,731	
.068		.0139	23,826	
.068		.0142	24,947	
.069		.0145	26,094	

5 Ohms Resistance.

Diam.	Area.	Weight per foot.	Total Weight.	Cost.
.051		.0080	9,907	
.052		.0083	10,556	
.053		.0085	11,227	
.054		.0088	11,917	
.055		.0090	12,629	
.055		.0093	13,360	
.056		.0095	14,113	
.057		.0098	14,886	
.058		.0101	15,680	
.058		.0103	16,495	
.059		.0106	17,329	
.060		.0108	18,185	
.061		.0111	19,061	
.061		.0113	19,958	
.062		.0116	20,875	

6 Ohms Resistance

Diam.	Area.	Weight per foot.	Total Weight	Cost.
,047		,0067	8,255	
,048		,0069	8,797	
,048		,0071	9,355	
,049		,0073	9,931	
,050		,0075	10,524	
,051		,0077	11,134	
,051		,0080	11,761	
,052		,0082	12,405	
,053		,0084	13,067	
,053		,0086	13,746	
,054		,0088	14,441	
,055		,0090	15,154	
,055		,0092	15,886	
,056		,0095	16,632	
,057		,0097	17,388	

7 Ohms Resistance.

Diam.	Area.	Weight per foot.	Total Weight	Cost.
,043		,0057	7,076	
,044		,0059	7,540	
,045		,0061	8,019	
,046		,0063	8,512	
,046		,0064	9,021	
,047		,0066	9,543	
,047		,0068	10,086	
,048		,0070	10,633	
,049		,0072	11,200	
,049		,0073	11,782	
,050		,0075	12,378	
,051		,0077	12,989	
,051		,0079	13,615	
,052		,0081	14,256	
,052		,0083	14,911	

8 Ohms Resistance

Diam.	Area.	Weight per foot.	Total Weight.	Cost.
,041		,0050	6,192	
,041		,0052	6,598	
,042		,0053	7,017	
,043		,0055	7,448	
,043		,0056	7,893	
,044		,0058	8,350	
,044		,0060	8,821	
,045		,0061	9,304	
,046		,0063	9,800	
,046		,0064	10,309	
,047		,0066	10,893	
,047		,0068	11,366	
,048		,0069	11,913	
,048		,0071	12,474	
,049		,0073	13,047	

9 Ohms Resistance.

Diam.	Area.	Weight per foot.	Total Weight.	Cost.
,038		,0044	5,580	
,039		,0046	5,945	
,040		,0047	6,323	
,040		,0049	6,712	
,041		,0050	7,016	
,041		,0052	7,422	
,042		,0053	7,840	
,042		,0054	8,270	
,043		,0056	8,711	
,044		,0057	9,164	
,044		,0059	9,627	
,045		,0060	10,103	
,045		,0062	10,590	
,046		,0063	11,088	
,046		,0064	11,598	

10 Ohms Resistance

Diam.	Area.	Weight per foot.	Total Weight.	Cost.
.036		.0040	4,953	
.037		.0041	5,277	
.038		.0043	5,612	
.038		.0044	5,958	
.039		.0045	6,314	
.039		.0046	6,680	
.040		.0048	7,056	
.040		.0049	7,443	
.041		.0050	7,840	
.041		.0052	8,247	
.042		.0053	8,665	
.042		.0054	9,092	
.043		.0055	9,531	
.043		.0057	9,979	
.044		.0058	10,438	

1/2 Ohm Resistance

Distance	Length of Cond.	Diam.	Area.	Weight per foot.	Total Weight	Cost.
920	1840	,198			218,100	
940	1880	,200			227,686	
960	1920	,202			237,478	
980	1960	,204			247,464	
1000	2000	,206			257,680	
1020	2040	,208			268,090	
1040	2080	,210			278,706	
1060	2120	,212			290,866	
1080	2160	,214			300,558	
1100	2200	,216			311,792	
1120	2240	,218			323,234	
1140	2280	,220			334,880	
1160	2320	,222			346,734	
1180	2360	,224			358,794	
1200	2400	,226			371,058	

1 Ohm Resistance

Diam.	Area.	Weight per foot.	Total Weight	Cost.
,140			109,050	
,141			113,843	
,143			118,739	
,144			123,732	
,146			128,840	
,147			134,045	
,149			139,353	
,150			145,433	
,152			150,279	
,153			155,896	
,154			161,617	
,156			167,440	
,157			173,367	
,159			179,397	
,160			185,529	

1½ Ohms Resistance

Diam.	Area.	Weight per foot.	Total Weight	Cost
.114			72,700	
.116			75,895	
.117			79,159	
.118			82,488	
.119			85,893	
.120			89,363	
.122			92,902	
.123			96,955	
.124			100,186	
.125			103,931	
.126			107,745	
.127			111,627	
.128			115,578	
.129			119,598	
.131			123,686	

2 Ohms Resistance

Diam.	Area.	Weight per foot.	Total Weight	Cost
.099			54,525	
.100			56,922	
.101			59,370	
.102			61,866	
.103			64,420	
.104			67,023	
.105			69,677	
.106			72,717	
.107			75,140	
.108			77,948	
.109			80,809	
.110			83,720	
.111			86,684	
.112			89,699	
.113			92,765	

2½ Ohms Resistance

Diam.	Area	Weight per foot.	Total Weight	Cost.
,089			43,620	
,090			45,537	
,090			47,496	
,091			49,495	
,092			51,536	
,093			53,618	
,094			55,741	
,095			58,173	
,096			60,112	
,097			62,358	
,098			64,647	
,099			66,976	
,099			69,347	
,100			71,759	
,101			74,212	

3 Ohms Resistance

Diam.	Area.	Weight per foot.	Total Weight	Cost.
,081			36,350	
,082			37,948	
,083			39,580	
,083			41,244	
,084			42,947	
,085			44,682	
,086			46,451	
,087			48,478	
,088			50,093	
,088			51,965	
,089			53,872	
,090			55,813	
,091			57,789	
,092			59,799	
,092			61,843	

4 Ohms Resistance

Diam.	Area.	Weight per foot.	Total Weight	Cost.
			27,263	
			28,461	
			29,685	
			30,933	
			32,210	
			33,511	
			34,838	
			36,358	
			37,570	
			38,974	
			40,404	
			41,860	
			43,342	
			44,849	
			46,382	

5 Ohms Resistance.

Diam.	Area.	Weight per foot.	Total Weight	Cost.
			21,810	
			22,769	
			23,748	
	Sixty 8		24,746	
			25,768	
			26,809	
			27,871	
			29,087	
			30,056	
			31,179	
			32,323	
			33,488	
			34,673	
			35,879	
			37,106	

6 Ohms Resistance.

Diam.	Area	Weight per foot.	Total Weight	Cost.
			18,175	
			18,974	
			19,790	
			20,622	
			21,473	
			22,341	
			23,226	
			24,239	
			25,047	
			25,983	
			26,936	
			27,907	
			28,895	
			29,733	
			30,922	

7 Ohms Resistance.

Diam.	Area.	Weight per foot.	Total Weight	Cost.
			15,579	
			16,263	
			16,963	
			17,676	
			18,406	
			19,149	
			19,908	
			20,776	
			21,468	
			22,271	
			23,088	
			23,920	
			24,767	
			25,628	
			26,504	

8 Ohms Resistance

Diam.	Area.	Weight per foot	Total Weight.	Cost.
			13,631	
			14,230	
			14,842	
			15,467	
			16,105	
			16,756	
			17,419	
			18,179	
			18,785	
			19,487	
			20,208	
			20,930	
			21,671	
			22,425	
			23,191	

9 Ohms Resistance.

Diam.	Area.	Weight per foot.	Total Weight.	Cost.
			12,117	
			12,649	
			13,193	
			13,748	
			14,315	
			14,894	
			15,484	
			16,159	
			16,698	
			17,322	
			17,957	
			18,605	
			19,263	
			19,933	
			20,614	

10 Ohms Resistance.

Diam.	Area.	Weight per foot	Total Weight	Cost.
			10,905	
			11,384	
			11,874	
			12,373	
			12,884	
			13,405	
			13,935	
			14,543	
			15,028	
			15,590	
			16,162	
			16,744	
			17,337	
			17,940	
			18,553	

½ Ohm.

Distance	Length of Conductor	Diam. inches	Area. sq. in.	Weight per foot. lbs.	Total Weight lbs.	Cost. $
5000	10000	.461	.1672	.6443	6443.00	
5020	10040	.462	.1678	.6469	6494.65	
5040	10080	.463	.1685	.6495	6546.50	
5060	10120	.464	.1692	.6520	6598.56	
5080	10160	.465	.1698	.6546	6650.82	
5100	10200	.466	.1705	.6572	6703.30	
5120	10240	.467	.1712	.6598	6755.98	
5140	10280	.468	.1719	.6623	6808.86	
5160	10320	.469	.1725	.6649	6861.95	
5180	10360	.470	.1732	.6675	6915.25	
5200	10400	.471	.1739	.6701	6968.75	
5220	10440	.471	.1745	.6727	7022.46	
5240	10480	.472	.1752	.6752	7076.37	
5260	10520	.473	.1759	.6778	7130.49	
5280	10560	.474	.1765	.6804	7184.82	

1 Ohm.

Diam.	Area.	Weight per foot.	Total Weight.	Cost.
.326	.0836	.3222	3221.50	
.327	.0839	.3235	3247.33	
.328	.0843	.3248	3273.25	
.328	.0846	.3260	3299.28	
.329	.0849	.3273	3325.41	
.329	.0853	.3286	3351.65	
.330	.0856	.3299	3377.99	
.331	.0860	.3312	3404.43	
.331	.0863	.3325	3430.98	
.332	.0866	.3338	3457.63	
.333	.0870	.3351	3484.38	
.333	.0873	.3364	3511.23	
.334	.0876	.3376	3538.19	
.335	.0880	.3389	3565.25	
.335	.0883	.3402	3592.41	

1/2 Ohms.

Diam.	Area.	Weight per foot.	Total weight.	Cost.
.266	.0557	.2148	2147.67	
.267	.0559	.2156	2164.88	
.267	.0562	.2165	2182.17	
.268	.0564	.2173	2199.52	
.268	.0566	.2182	2216.94	
.269	.0568	.2191	2234.43	
.270	.0571	.2199	2251.99	
.270	.0573	.2208	2269.62	
.271	.0575	.2216	2287.32	
.271	.0577	.2225	2305.08	
.272	.0580	.2234	2322.92	
.272	.0582	.2242	2340.82	
.273	.0584	.2251	2358.79	
.273	.0586	.2259	2376.83	
.274	.0588	.2268	2394.94	

2 Ohms.

Diam.	Area.	Weight per foot.	Total weight.	Cost.
.231	.0418	.1611	1610.75	
.231	.0420	.1617	1623.66	
.232	.0421	.1624	1636.63	
.232	.0423	.1630	1649.64	
.233	.0425	.1637	1662.71	
.233	.0426	.1643	1675.83	
.233	.0428	.1650	1689.00	
.234	.0430	.1656	1702.22	
.234	.0431	.1662	1715.49	
.235	.0433	.1669	1728.81	
.235	.0435	.1675	1742.19	
.236	.0436	.1682	1755.62	
.236	.0438	.1688	1769.09	
.237	.0440	.1695	1782.62	
.237	.0441	.1701	1796.21	

2 1/2 Ohms.

Diam.	Area.	Weight per foot.	Total weight.	Cost.
.206	.0334	.1289	1288.60	
.207	.0336	.1294	1298.93	
.207	.0337	.1299	1309.30	
.208	.0338	.1304	1319.71	
.208	.0340	.1309	1330.16	
.208	.0341	.1314	1340.66	
.209	.0342	.1320	1351.20	
.209	.0344	.1325	1361.77	
.210	.0345	.1330	1372.39	
.210	.0346	.1335	1383.05	
.210	.0348	.1340	1393.75	
.211	.0349	.1345	1404.49	
.211	.0350	.1350	1415.27	
.212	.0352	.1356	1426.10	
.212	.0353	.1361	1436.96	

3 Ohms.

Diam.	Area.	Weight per foot.	Total weight.	Cost.
.188	.0279	.1074	1073.83	
.189	.0280	.1078	1082.44	
.189	.0281	.1083	1091.08	
.189	.0282	.1087	1099.76	
.190	.0283	.1091	1108.47	
.190	.0284	.1095	1117.22	
.191	.0285	.1100	1126.00	
.191	.0287	.1104	1134.81	
.191	.0288	.1108	1143.66	
.192	.0289	.1113	1152.54	
.192	.0290	.1117	1161.46	
.192	.0291	.1121	1170.41	
.193	.0292	.1125	1179.40	
.193	.0293	.1130	1188.42	
.194	.0294	.1134	1197.47	

4 Ohms.

Diam.	Area.	Weight per foot.	Total weight.	Cost.
.163	.0209	.0806	805.38	
.163	.0210	.0809	811.83	
.164	.0211	.0812	818.31	
.164	.0212	.0815	824.82	
.164	.0212	.0818	831.35	
.165	.0213	.0822	837.91	
.165	.0214	.0825	844.50	
.165	.0215	.0828	851.11	
.166	.0216	.0831	857.75	
.166	.0217	.0835	864.41	
.166	.0218	.0838	871.10	
.167	.0218	.0841	877.81	
.167	.0219	.0844	884.55	
.167	.0220	.0847	891.31	
.168	.0221	.0851	898.10	

5 Ohms.

Diam.	Area.	Weight per foot.	Total weight.	Cost.
.146	.0167	.0644	644.30	
.146	.0168	.0647	649.47	
.146	.0169	.0650	654.65	
.147	.0169	.0652	659.86	
.147	.0170	.0655	665.08	
.147	.0171	.0657	670.33	
.148	.0171	.0660	675.60	
.148	.0172	.0662	680.89	
.148	.0173	.0665	686.20	
.148	.0173	.0668	691.53	
.149	.0174	.0670	696.88	
.149	.0175	.0673	702.25	
.149	.0175	.0675	707.64	
.150	.0176	.0678	713.05	
.150	.0177	.0680	718.48	

6 Ohms.

Diam.	Area.	Weight per foot.	Total weight.	Cost.
.133	.0139	.0537	536.92	
.133	.0140	.0539	541.22	
.134	.0141	.0541	545.54	
.134	.0141	.0543	549.88	
.134	.0142	.0546	554.24	
.135	.0142	.0548	558.61	
.135	.0143	.0550	563.00	
.135	.0143	.0552	567.41	
.135	.0144	.0554	571.83	
.136	.0144	.0556	576.27	
.136	.0145	.0559	580.73	
.136	.0146	.0561	585.21	
.136	.0146	.0563	589.70	
.137	.0147	.0565	594.21	
.137	.0147	.0567	598.74	

7 Ohms.

Diam.	Area.	Weight per foot.	Total weight.	Cost.
.123	.0119	.0460	460.21	
.124	.0120	.0462	463.90	
.124	.0120	.0464	467.61	
.124	.0121	.0466	471.33	
.124	.0121	.0468	475.06	
.125	.0122	.0469	478.81	
.125	.0122	.0471	482.57	
.125	.0123	.0473	486.35	
.125	.0123	.0475	490.14	
.126	.0124	.0477	493.95	
.126	.0124	.0479	497.77	
.126	.0125	.0481	501.60	
.126	.0125	.0482	505.46	
.126	.0126	.0484	509.32	
.127	.0126	.0486	513.20	

8 Ohms.

Diam.	Area.	Weight per foot.	Total weight.	Cost.
.115	.0105	.0403	402.69	
.116	.0105	.0404	405.92	
.116	.0105	.0406	409.16	
.116	.0106	.0408	412.41	
.116	.0106	.0409	415.68	
.116	.0107	.0411	418.96	
.117	.0107	.0412	422.25	
.117	.0108	.0414	425.55	
.117	.0108	.0416	428.87	
.117	.0108	.0417	432.21	
.118	.0109	.0419	435.55	
.118	.0109	.0421	438.90	
.118	.0110	.0422	442.27	
.118	.0110	.0424	445.66	
.119	.0110	.0425	449.05	

9. Ohms.

Diam.	Area.	Weight per foot.	Total weight.	Cost.
.109	.0093	.0358	357.94	
.109	.0093	.0359	360.81	
.109	.0094	.0361	363.69	
.109	.0094	.0362	366.59	
.110	.0094	.0364	369.49	
.110	.0095	.0365	372.41	
.110	.0095	.0367	375.33	
.110	.0096	.0368	378.27	
.110	.0096	.0369	381.22	
.111	.0096	.0371	384.18	
.111	.0097	.0372	387.15	
.111	.0097	.0374	390.14	
.111	.0097	.0375	393.13	
.112	.0098	.0377	396.14	
.112	.0098	.0378	399.16	

10 Ohms.

Diam.	Area.	Weight per foot.	Total weight.	Cost.
.103	.0084	.0322	322.15	
.103	.0084	.0324	324.73	
.104	.0084	.0325	327.33	
.104	.0085	.0326	329.93	
.104	.0085	.0327	332.54	
.104	.0085	.0329	335.17	
.104	.0086	.0330	337.80	
.105	.0086	.0331	340.44	
.105	.0086	.0333	343.10	
.105	.0087	.0334	345.76	
.105	.0087	.0335	348.44	
.105	.0087	.0336	351.12	
.106	.0088	.0338	353.82	
.106	.0088	.0339	356.53	
.106	.0088	.0340	359.24	

55 5

84

1/2 Ohm.

Distance	Length of Conductor	Diam.	Area.	Weight per foot.	Total Weight.	Cost.
4700	9400	.447	.1571	.6056	5693.16	1423.29
4720	9440	.448	.1578	.6082	5741.61	1435.43
4740	9480	.449	.1585	.6108	5790.35	1447.59
4760	9520	.450	.1591	.6134	5839.31	1459.83
4780	9560	.451	.1598	.6160	5888.51	1472.13
4800	9600	.452	.1605	.6185	5937.87	1484.47
4820	9640	.453	.1611	.6211	5987.45	1496.86
4840	9680	.454	.1618	.6237	6037.25	1509.31
4860	9720	.455	.1625	.6263	6087.24	1521.81
4880	9760	.456	.1631	.6288	6137.45	1534.36
4900	9800	.457	.1638	.6314	6187.86	
4920	9840	.458	.1645	.6340	6238.47	
4940	9880	.459	.1651	.6366	6289.29	
4960	9920	.459	.1658	.6391	6340.33	
4980	9960	.460	.1665	.6417	6391.56	

1 Ohm.

Diam.	Area.	Weight per foot.	Total weight.	Cost.
.316	.0786	.3028	2846.58	
.317	.0789	.3041	2870.81	
.318	.0793	.3054	2895.18	
.318	.0796	.3067	2919.66	
.319	.0799	.3080	2944.26	
.320	.0803	.3093	2968.94	
.320	.0806	.3106	2993.73	
.321	.0809	.3119	3018.63	
.322	.0813	.3132	3043.62	
.322	.0816	.3144	3068.73	
.323	.0819	.3157	3093.93	
.324	.0823	.3170	3119.24	
.324	.0826	.3183	3144.65	
.325	.0829	.3196	3170.17	
.326	.0833	.3209	3195.78	

1½ Ohms.

Diam.	Area.	Weight per foot.	Total weight	Cost.
.258	.0524	.2019	1897.72	
.259	.0526	.2027	1913.87	
.260	.0528	.2036	1930.12	
.260	.0530	.2045	1946.44	
.260	.0533	.2053	1962.84	
.261	.0535	.2062	1979.29	
.262	.0537	.2070	1995.82	
.262	.0539	.2079	2012.42	
.263	.0542	.2088	2029.08	
.263	.0544	.2096	2045.82	
.264	.0546	.2105	2062.62	
.264	.0548	.2113	2079.49	
.265	.0550	.2122	2096.43	
.265	.0553	.2130	2113.44	
.266	.0555	.2139	2130.52	

2 Ohms.

Diam.	Area.	Weight per foot.	Total weight	Cost.
.224	.0393	.1514	1423.29	
.224	.0395	.1521	1435.40	
.225	.0396	.1527	1447.59	
.225	.0398	.1534	1459.83	
.226	.0400	.1540	1472.13	
.226	.0401	.1546	1484.47	
.226	.0403	.1553	1496.86	
.227	.0405	.1559	1509.31	
.227	.0406	.1566	1521.81	
.228	.0408	.1572	1534.36	
.228	.0410	.1580	1546.97	
.229	.0411	.1585	1559.62	
.229	.0413	.1592	1572.32	
.230	.0415	.1598	1585.08	
.230	.0416	.1604	1597.89	

2½ Ohms.

Diam.	Area	Weight per foot.	Total Weight	Cost.
.200	.0314	.1211	1138.63	
.200	.0316	.1216	1148.32	
.201	.0317	.1222	1158.07	
.201	.0318	.1227	1167.86	
.202	.0320	.1232	1177.70	
.202	.0321	.1237	1187.57	
.203	.0322	.1242	1197.49	
.203	.0324	.1247	1207.45	
.203	.0325	.1253	1217.45	
.204	.0326	.1258	1227.49	
.204	.0328	.1263	1237.57	
.205	.0329	.1268	1247.69	
.205	.0330	.1273	1257.86	
.205	.0332	.1278	1268.07	
.206	.0333	.1283	1278.31	

3 Ohms.

Diam.	Area.	Weight per foot.	Total Weight	Cost.
.183	.0262	.1009	948.86	
.183	.0263	.1014	956.94	
.183	.0264	.1018	965.06	
.184	.0265	.1022	973.22	
.184	.0266	.1027	981.42	
.185	.0268	.1031	989.65	
.185	.0269	.1035	997.91	
.185	.0270	.1040	1006.21	
.186	.0271	.1044	1014.54	
.186	.0272	.1048	1022.93	
.186	.0273	.1052	1031.31	
.187	.0274	.1057	1039.75	
.187	.0275	.1061	1048.22	
.188	.0276	.1065	1056.72	
.188	.0278	.1070	1065.26	

4 Ohms.

Diam.	Area	Weight per foot.	Total Weight	Cost.
.158	.0197	.0757	711.65	
.158	.0197	.0760	717.70	
.159	.0198	.0764	723.80	
.159	.0199	.0767	729.92	
.159	.0200	.0770	736.07	
.160	.0201	.0773	742.24	
.160	.0202	.0777	748.43	
.160	.0202	.0780	754.66	
.161	.0203	.0783	760.91	
.161	.0204	.0786	767.20	
.161	.0205	.0789	773.48	
.162	.0206	.0793	779.81	
.162	.0207	.0796	786.16	
.162	.0207	.0799	792.54	
.163	.0208	.0802	798.94	

5 Ohms.

Diam.	Area	Weight per foot.	Total Weight	Cost.
.141	.0157	.0606	569.32	
.142	.0158	.0608	574.16	
.142	.0159	.0611	579.04	
.142	.0159	.0613	583.93	
.143	.0160	.0616	588.85	
.143	.0161	.0619	593.79	
.143	.0161	.0621	598.75	
.144	.0162	.0624	603.73	
.144	.0163	.0626	608.72	
.144	.0163	.0629	613.76	
.144	.0164	.0631	618.79	
.145	.0165	.0634	623.85	
.145	.0165	.0637	628.93	
.145	.0166	.0639	634.03	
.146	.0167	.0642	639.16	

6 ohms.

Diam.	Area	Weight per foot	Total Weight	Cost
.129	.0131	.0505	474.43	
.129	.0132	.0507	478.47	
.130	.0132	.0509	482.53	
.130	.0133	.0511	486.61	
.130	.0133	.0513	490.71	
.130	.0134	.0516	494.82	
.131	.0134	.0518	498.96	
.131	.0135	.0520	503.11	
.131	.0136	.0522	507.27	
.132	.0136	.0524	511.46	
.132	.0137	.0526	515.66	
.132	.0137	.0528	519.87	
.132	.0138	.0531	524.11	
.133	.0138	.0533	528.36	
.133	.0139	.0535	532.63	

7 ohms.

Diam.	Area.	Weight per foot	Total Weight	Cost
.120				
.120				
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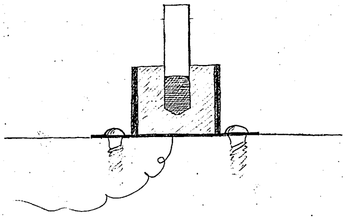

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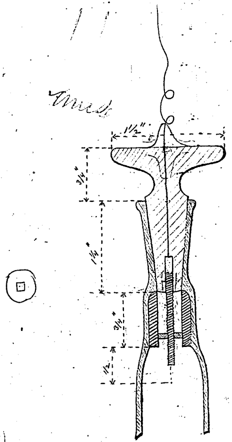

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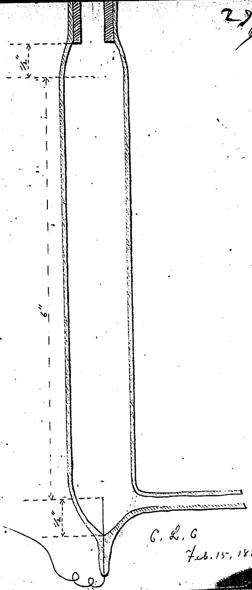

C. L. G
Feb. 15, 1880.

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Depth	Tow'd	Length		Cir 1000	
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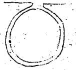

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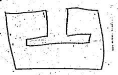

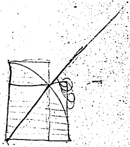

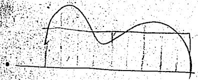

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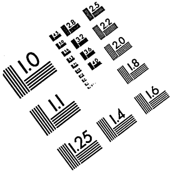

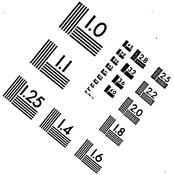

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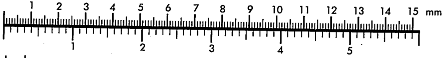

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